

ZOOLOGICAL LECTURES,

delivered at the

ROYAL INSTITUTION

by

GEORGE SHAW, M.D. F.R.S. &c.

WITH PLATES

from the first Authorities and most select specimens

Engraved principally by

MRS. GRIFFITH.

WEARNS
COLLECTION



VOL. II.

LONDON,
Printed for G. Kearsley, Fleet Street,
1809.

ZOOLOGICAL LECTURES

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THE UNIVERSITY OF CHICAGO

Directions for placing the Plates in vol. II.

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LECTURES,

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LECTURE VII.

WE are now arrived at a class or tribe of the animal kingdom highly remarkable both for singular external appearance and internal conformation. These animals differ from viviparous quadrupeds and from birds in the structure of those important organs the heart and lungs. The heart in these amphibious animals may be said to have but one ventricle or cavity, instead of two as in viviparous quadrupeds and birds. For though some variation takes place in the formation of this organ in the different tribes of the Amphibia, yet the general effect with respect to the circula-

tion is the same; and therefore in a general way of speaking they may be properly said to have what is called a unilocular heart, or furnished but with a single cavity.

The blood of the Amphibia is always far less warm than that of quadrupeds and birds; for which reason they are often distinguished by the title of cold-blooded animals: in this particular they resemble fishes, which are also, comparatively speaking, cold-blooded animals.

The red particles of the blood itself both in the Amphibia and Fishes, as well as in birds, are of an oval shape; not round as in the viviparous quadrupeds. Their appearance when highly magnified, is that of an oval transparent vesicle or bladder, with a smaller and somewhat rounder central one inclosed: they are also much larger in proportion. With respect to the structure of the lungs in the animals of this tribe, the best method of giving a clear general idea will be to observe, that the lungs in most animals which are furnished with those organs, consist of vesicles or air-bladders more or less large in proportion to the blood-vessels distributed between them. Now in quadrupeds the vascular system is so extremely large,

or bears so great a proportion to the vesicular one, or that of the air-cells, that the latter are scarce distinctly visible without a close and minute survey; but on the contrary, in the Amphibia the vesicular system greatly preponderates over the vascular, insomuch that in some of the tribe, as in the Tortoises for instance, the lungs seem to consist almost entirely of bladders or vesicles, while the blood-vessels distributed through them, and constituting their vascular system, appear very slight in comparison. In Frogs the difference is still more striking; for in these animals the lungs, when in a state of inflation, exhibit the appearance of a pair of bladders, the internal part or cavity of which is slightly subdivided into numerous cells, reaching but a little way down, or in such a manner as to leave a large central vacuity in each lobe of the lungs; while the blood-vessels are distributed in a very elegant and beautiful manner between them. In many of the Lizards the lungs seem even less complex than in the Frogs; for in some of the smaller Lizards, and particularly in the common Water-Newt, or *L. aquatica* of Linnæus, the lungs are merely a pair of lengthened bladders, without any internal

subdivisions, and exhibit the artery and vein in a more simple state of ramification than in the Frogs. In the Serpent tribe the structure of the lungs seems to run between that of Frogs and Lizards; the upper part being divided internally into smaller cells, while the remainder degenerates into a mere continued bladder as in the Lizards.

The whole tribe of the proper or Linnæan Amphibia, viz. the Tortoises, Frogs, Lizards, and Serpents, possess a kind of voluntary power by which they are able at pleasure to suspend their respiration; so as to continue for a long time without breathing, by retaining air within their lungs, instead of being obliged to discharge it frequently, as quadrupeds and birds are obliged to do. Linnæus therefore, among other characters of the Amphibia gives that of *arbitrary lungs*, *pulmones arbitrarii*, or such as can at pleasure suspend respiration, without injuring the animal. Upon this principle it is that these animals may be confined in the closest situations without seeming to suffer any material inconvenience, and many of them are calculated for residing with almost equal ease either on land or under water. In Frogs so strong is this power of retaining air

in the lungs, without any necessity of renewal, that the common Frog has been known to survive six or seven days when confined by a weight at a considerable depth under water*.

Many of the amphibious animals are capable of supporting a long continued abstinence from food: this is particularly the case in the Serpent tribe and in some of the Lizards; and so tenacious are they of the principle of life, that the heart in many of the tribe will continue its pulsations for a long time after being taken from the body; nay, even when it has apparently ceased to beat, it may again be stimulated into exertion by the application of any sharp-pointed body or other irritating substance.

All the Amphibia are oviparous; some of them depositing hard eggs, or covered with a calcarious shell as in birds, while others deposit soft eggs, or spawn, either in the form of continued strings or chains of eggs; or else in heaps or loose clusters. In several of the Amphibia however, the eggs are hatched internally, as in the Viper tribe and in

* It also lies concealed during the winter season, in a state of torpidity beneath the mud of ponds and lakes.

some of the Lizards. The young of such as deposit hard or shelled eggs are commonly produced in their perfect or complete form, or differing from the parent animal in size alone; but the young of many of those which are produced from spawn or soft eggs pass through a kind of tadpole state, and appear for some time in a form very different from that which they afterwards assume. But these particulars will be farther attended to as we pass through the different genera.

The first division of the Linnæan Amphibia consists of but four distinct genera or sets, comprising all the kinds of Tortoises, Frogs and Lizards, one particular kind of which, on account of its very peculiar form, constitutes a distinct genus from the rest. These four genera are entitled *Testudo*, *Rana*, *Draco*, and *Lacerta*, or *Tortoise*, *Frog*, *Dragon*, and *Lizard*. These animals constitute the four-footed Amphibia, and are what the older writers on natural history, as well as some of the moderns, have called *Oviparous Quadrupeds*. Amongst others, the Count de Cépède, in his continuation of Buffon's natural history, chooses to call them by this title, and it must be confessed to be by no means an unscientific or

improper one, though liable to some criticisms. I should observe that Linnæus, from a mistaken idea, relative to the structure of their gills, which he conceived to be accompanied by a kind of lungs, admitted into the Amphibia several of the Fish tribe, as the *Lampreys*, the *Rays*, the *Sharks* and many others, which the more accurate researches of later naturalists have restored to their proper situation. The particular reasons for the Linnæan arrangement of them will be explained when we arrive at that tribe of animals: at present we shall confine ourselves to the genuine Amphibia.

Of these the first genus or *Tortoise*, (*Testudo*,) is characterized by having *the body defended by a strong bony or horny covering: the mouth without teeth, the upper jaw closing over the edges of the lower.* Tortoises are divided into the land and sea-Tortoises, which latter are termed *Turtles*, and have the feet so-formed as to bear a sort of resemblance to fins: there are also river or fresh-water Tortoises. All the land Tortoises have the feet divided into toes and furnished with claws; and the river or fresh-water Tortoises have their feet more or less webbed. Of the land Tortoises

one of the most common is the *T. Græca* of Linnæus or Grecian Tortoise, which is supposed to be a native of almost all the countries bordering on the Mediterranean sea, and to be more frequent in Greece than in other regions. It is found in the scattered islands of the Archipelago, and in Corsica and Sardinia. It also occurs in many parts of Africa.

In no branch of natural history have more errors prevailed than in that relating to the Tortoise tribe, and more particularly with respect to the true distinction of the species; the general similarity being very great, and the individuals occasionally varying much in size, colours, and other particulars, according to the different periods of their growth, and their state of perfection. Their specific characters given by Linnæus are proved, from later observations, to be entirely insufficient for the purpose of accurate distinction; and the same must be said of those in the Gmelinian edition of the *Systema Naturæ*. The descriptions of Count de Cèpede in his *History of Oviparous Quadrupeds*, have by no means tended to dispel the general obscurity, but in some instances, have rather increased it. One observation



COMMON TORTOISE.



of Mr. Schoepf, a German author who has written on this subject, is particularly important, and may tend to save zoological students a great deal of trouble; viz. that the apparent number of the claws or projecting extremities on the feet of the marine Tortoises or Turtles, appears to be no certain criterion of the species, but is found to vary in such a manner as to contradict the Linnæan characters. Thus on collating a number of specimens of the *Testudo Mydas* or common green Turtle, some will be found with only a single claw on each foot, others with two, or even three, and others with two on the fore-feet and one on the hind. It also appears that the same variation occasionally takes place in the number of claws on the feet of some of the land-Tortoises, and particularly in those of the Greek or common Tortoise, the more particular history of which I shall now proceed to give in as few words as possible. In its native regions it is said to make its first appearance in the month of February, and in June lays its eggs in some snowy spot, having first scratched a hole for their reception. The young are hatched after the first rains in Sep-

tember, and are about the size of a walnut. The general length of the shell, in the full-grown animal, is about six or eight inches, which latter measure it very seldom exceeds: the shell is of an extremely convex form, and is composed, as in most other Tortoises, of thirteen middle divisions, and about twenty-five marginal ones; the general colour is a blackish-brown, with broad and somewhat irregular blotches of pale yellow, varying in different individuals: the head is rather small than large; the legs short, and the feet commonly furnished with four strong claws on each; sometimes with five. This animal lives to a most extraordinary age, several well attested examples being adduced of its having considerably exceeded the period of a century. One of the most remarkable instances is that of a Tortoise introduced into the archiepiscopal garden at Lambeth, in the time of Archbishop Laud, and as near as can be collected from its history, about the year 1633, which continued to live there till the year 1753, when it was supposed to have perished rather from accidental neglect on the part of the gardener, than from the mere effect of age. This

Tortoise has had the honour of being commemorated by Derham*, and many other writers, and its shell is preserved in the library of the palace at Lambeth†.

The general manners of the Tortoise, in a state of domestication in this country, are very agreeably detailed by Mr. White, in his History of Selbourn. "A Land Tortoise," says Mr. White, "which has been kept thirty years in a little walled court, retires under ground about the middle of November, and comes forth again about the middle of April. When it first appears in the spring, it discovers very little inclination for food, but in the height of summer grows voracious."

* In a copy of the work entitled *Memoirs for the Natural History of Animals*, from the French academy, and which was once the property of Derham, the following MS. note occurs.

"I imagine Land-Tortoises, when arrived at a certain pitch, cease growing. For that I saw, Aug. 11, 1712, in my lord archbishop of Canterbury's garden, which had been there ever since archbishop Juxon's time, and is accounted to be above 60 years old, was of the same size I have seen others of, of larger size, and much younger."

† This memorable Tortoise appears to have exceeded the usual dimensions of its species; the shell measuring ten inches in length, and six and a half in breadth.

cious; and then, as the summer declines, its appetite declines; so that for the last weeks in autumn it hardly eats at all. Milky plants, such as lettuces, dandelions, sowthistles, &c. are its principal food. On the first of November, 1771, I remarked that the Tortoise began to dig the ground, in order to form its hybernaculum, which it had fixed on just beside a great tuft of *Hepaticas*. It scrapes out the ground with its fore feet, and throws it up over its back with its hind, but the motion of its legs is ridiculously slow, little exceeding the hour hand of a clock. Nothing can be more assiduous than this creature, night and day, in scooping the earth, and forcing its great body into the cavity; but as the noons of that season proved unusually warm and sunny, it was continually interrupted, and called forth by the heat in the middle of the day, and though I continued there till the thirteenth of November, yet the work remained unfinished. Harsher weather, and frosty mornings, would have quickened its operations. No part of its behaviour ever struck me more than the extreme timidity it always expresses with regard to rain; for though it has a shell that would secure it against the wheel of a loaded

cart, yet does it discover as much solicitude about rain as a lady dressed in all her best attire, shuffling away on the first sprinklings, and running its head up in a corner. If attended to, it becomes an excellent weather-glass, for as sure as it walks elate, and, as it were on tip-toe, feeding with great earnestness, in a morning, so sure will it rain before night. It is totally a diurnal animal, and never pretends to stir after it becomes dark."

"The Tortoise," adds Mr. W. "like other reptiles, has an arbitrary stomach, as well as lungs, and can refrain from eating, as well as breathing, for a great part of the year. I was much taken with its sagacity, in discerning those that do it kind offices; for as soon as the good old lady comes in sight who has waited on it for more than thirty years, it hobbles towards its benefactress with awkward alacrity; but remains inattentive to strangers. Thus, not only "*the Ox knoweth his owner, and the Ass his master's crib,*" but the most abject and torpid of beings distinguishes the hand that feeds it, and is touched with the feelings of gratitude. This creature not only goes under the earth from the middle of November to the middle of April, but

sleeps great part of the summer ; for it goes to bed in the longest days at four in the afternoon, and often does not stir in the morning till late. Besides, it retires to rest for every shower, and does not move at all in wet days. When one reflects on the state of this strange being, it is a matter of wonder that Providence should bestow such a seeming waste of longevity on a reptile that appears to relish it so little as to squander away more than two thirds of its existence in a joyless stupor, and be lost to all sensation for months together in the profoundest of all slumbers ! Though he loves warm weather, he avoids the hot sun ; because his thick shell, when once heated, would, as the poet says of solid armour, ‘ *scald with safety.*’ He therefore spends the more sultry hours under the umbrella of a large cabbage-leaf, or amidst the waving forests of an asparagus bed. But as he avoids heat in the summer, so in the decline of the year, he improves the faint autumnal beams by getting within the reflection of a fruit-tree wall ; and though he has never read that planes inclining to the horizon receive a greater share of warmth, he inclines his shell by tilting it against the wall, to collect and admit every feeble ray.”

The Tortoise seems more tenacious of the vital principle than any other of the Amphibia. Redi informs us, that in making some experiments on vital motion, he, in the beginning of November, took a land tortoise, and made a large opening in its skull, and drew out all the brain, washing the cavity, so as to leave not the smallest part remaining, and then, leaving the hole open, set the animal at liberty. Notwithstanding this treatment, the Tortoise marched away, without seeming to have received the smallest injury; it however closed its eyes, and never opened them afterwards. In a short space the hole of the skull was seen to close, and in about three days there was a complete skin covering the wound; and in this manner the animal lived, without the brain, for six months, walking about, and moving its limbs as before. Redi also cut off the head of a Tortoise, which lived twenty-three days afterwards; and the head itself continued to snap the jaws for more than a quarter of an hour after its separation from the body. He repeated the experiment of taking out the brain upon several other Tortoises, both of land and fresh water; all of which lived for a considerable space without

the brain. He observed also, that having cut off the heads of some, and opening the bodies twelve days afterwards, the motion of the heart was still perceptible ; so slowly is the vital principle discharged from these inactive animals.

The most beautiful of all the Land Tortoises is the *T. Geometrica*, or Geometrical Tortoise, so named from the elegantly regular variegations of its shell, which is very convex, and of a black colour, with each piece marked by several bright yellow stripes radiating from a common centre. It is a native of many parts of Africa.

A species much allied to the geometrical, but much larger, is what I have myself described under the name of *T. radiata* or the Radiated Tortoise. It measures more than a foot in length ; is extremely convex, and nearly smooth, whereas the *geometrica* is remarkably tuberculated : the pattern is still more elaborately disposed than in the former, the rays or streaks being more numerous. It is a native of Madagascar, and as some say of America also.

The largest of all the Land-Tortoises is a species now called the *Indian Tortoise*. *T. Indica*. It was first described by Mons. Perrault,

PERCE TORTOISE.



T. ROSTRATA *Thunberg.*

in the accounts of animals published long ago by the French Academy. It grows to the length of four feet, and is entirely of a dull brown colour without any variegations. It is one of the numerous species confounded by the Count de Cépède with the Common Tortoise or *T. Græca*.

Of the river or fresh water Tortoises one of the most remarkable is the *T. ferox* or fierce Tortoise, a native of many parts of North America, and first described by Mr. Pennant in the Philosophical Transactions; its shield or shell is hard or bony only in the middle; the edges being soft and flexible: its colour is brown above and white beneath; the head is small, with a long, pointed snout, and a very long neck which is at pleasure withdrawn into the shell: the feet are very widely webbed. Unlike the rest of the tribe, it is an animal of swift motion, and when disturbed, springs forward with great fury to attack its assailant: its usual length is from one to two feet; but it is sometimes found far larger. It feeds on various water-animals as well as on vegetable substances.

The Sea Tortoises, or Turtles as they are commonly called, are distinguished from the rest by

their very large and long fin-shaped feet, in which are inclosed the bones of the toes; the first and second alone on each foot being furnished with visible or projecting claws; the rest not appearing beyond the edge. The shield, as in the Land Tortoises, consists of a strong bony covering, in which are imbedded the ribs, and which is coated externally with hard, horny plates; in one or two species much thicker than the horny covering or epidermis of the land Tortoises. There is however one species of Turtle, and that the largest of all others, which instead of a strong horny covering, has one of a leathery consistence, marked over the whole surface into small angular subdivisions which do not take away from the general smoothness of the whole: along the whole upper part run five prominent ribs or lines, while the under parts of the animal are bare, or destitute of any lower shell, so that this animal might form a distinct genus from the rest of the Turtle tribe. Its colour is olive-brown, and its size so great that it has been seen of the length of eight feet, and of the weight of a thousand pounds. It has been sometimes taken both on the coast of France and England. It is found

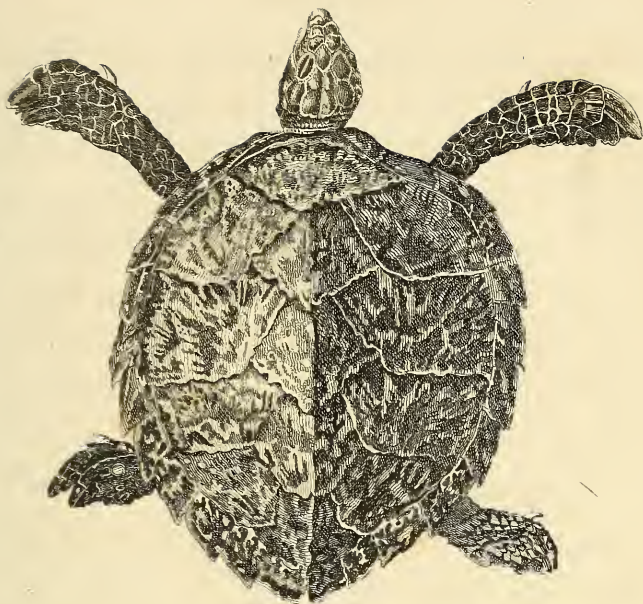
in the Mediterranean and Atlantic seas, and about some of the African coasts. A most magnificent specimen taken on the English coasts is preserved in the Leverian Museum.

The Green or Edible Turtle, which is the *T. Mydas* of Linnæus, grows also to a very large size; often measuring more than five feet in length, and weighing five or six hundred pounds. Its colour is a dull palish brown, with a few dusky variegations. The introduction of this animal as an article of luxury into England is of no very distant date, and can perhaps hardly be traced much farther than about fifty or sixty years backward. They are chiefly found about the Bahama islands, and seem to feed chiefly on marine vegetables, from which their fat acquires the greenish colour which gives name to the animal.

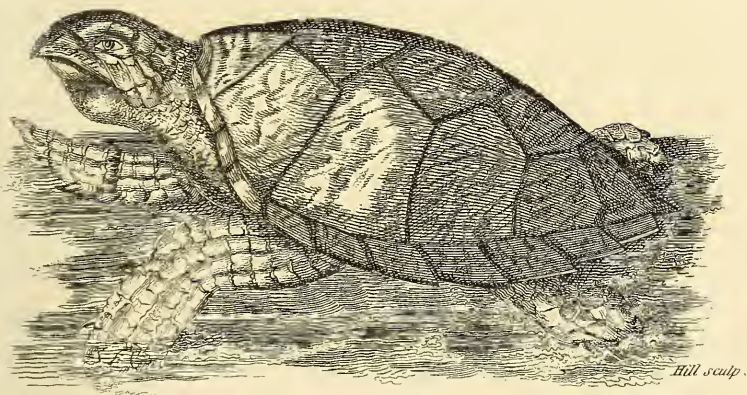
The *T. Caretta* of Linnæus or the Loggerhead Turtle, is of at least equal size to the former, and often superior: its colours are beautiful, having a finely variegated shell, but the horny pieces or divisions are too thin for the purposes of the artificers in tortoise-shell, and are therefore neglected in trade: as a species it may be distin-

guished both from the green and the true tortoise-shell turtle or Hawksbill by the more numerous divisions of the shell, which amount to fifteen instead of thirteen, which is the constant number in the rest. The Loggerhead Turtle is a very strong and fierce animal, and is even dangerous; defending itself with great vigour with its legs, and being able to break the strongest substances with its mouth. Aldrovandus tells us that on offering a thick walking-stick to one which he saw publicly exhibited at Bologna, the animal bit it in two in an instant.

The *T. imbricata*, the Hawksbill, or *imbri-cated Turtle*, is the species which affords the elegant substance commonly known by the name of Tortoise-shell, and of which such innumerable ornamental articles are prepared. This species of Turtle is called the imbricated Turtle, from the disposition of its scales, which lap over each other at the tips in the manner of tiles on a house, and by this particularity as well as by the number of its scales, which are always thirteen, it may be distinguished from the Loggerhead Turtle, in which the number is fifteen. The shape of the bill also, which is sharper and more



IMBRICATED TURTLE.



Hill sculp.

curved than in the Loggerhead Turtle, is another mark of distinction. The colour is a beautiful variegation of blackish brown and yellow, varying greatly in different individuals. This species is a native of the Asiatic seas, but is also found, though much more rarely, in the Atlantic, and even in the Mediterranean. Its general length is about three feet, but sometimes it is found much larger. The Greeks and Romans appear to have been highly partial to the use of Tortoise-shell as an ornamental article, decorating their doors, the pillars of their houses, and their beds with it. The great consumption of it at Rome may be guessed at by what Velleius Paterculus has related, who tells us that when the city of Alexandria was taken by Julius Cæsar, the magazines or warehouses were so full of this article, that he proposed to have made it the principal ornament of his triumph, as he did of ivory afterwards, during his triumph after the African war.

We now pass to the genus called *Rana* or Frog, consisting of all the animals comprehended under the general names of Frog and Toad. This is a singularly curious race of animals, though from prejudice often considered in an unfavourable

light. The character of the genus is, that the body is destitute of any particular covering except the mere skin; furnished with four feet, and without any tail. The most familiar example that can be given is the Common Frog, which is the *Rana temporaria* of Linnæus, which is almost every where seen in moist situations, where it can command a sufficient quantity of insects and small worms, which are its favourite food. As a species the Common Frog is distinguished by its yellowish-brown colour, spotted with black, and by a lengthened brown patch or streak beneath each eye. It often however varies in colour, running through all the shades of olive, and sometimes even of reddish brown. The form of the common Frog is light and elegant; the limbs finely calculated for the peculiar motions of the animal, and the hind feet strongly webbed, to assist its progress in the water, to which it occasionally retires during the heats of summer, and again during the frosts of winter, when it lies in a state of torpidity either plunged in the soft mud at the bottom of stagnant waters, or in the hollows beneath their banks, till it is awakened from its slumbers by the return of Spring. In the month of March it deposits its eggs, in large

COMMON FROG.



groupes or clustered masses; each egg being of a gelatinous substance, perfectly transparent, and containing the young animal in its centre under the form of a round black globule. In the space of about a month the globule assumes an oval shape, and soon after hatches; not in the form of a complete Frog but of what is termed a tadpole, and appearing, on a general view, to consist merely of head and tail; the former black and large, the latter slender, and bordered with a transparent finny margin. The motions of the tadpoles are very lively, and in the advanced state of Spring are so plentiful that the waters they inhabit appear blackened by their numbers. They live on the leaves of the plant called duckweed and on other small vegetable substances: during the early part of their growth they are furnished on each side the head with a pair of ramified breathing organs, which drop off when they are farther advanced in age; and when they have arrived at the age of five or six weeks, the hind-legs make their appearance, and soon afterwards the fore-legs. Some time after this the tail begins to decrease, and at length becomes quite obliterated. The animal now ventures upon land,

and no longer feeds on vegetable but on animal food, preying on the smaller kind of insects and worms. It does not arrive at its full size till at least five years old, and is supposed to live about fifteen.

The Frog which is so frequently eaten in many parts of the Continent is a different species, rather larger and of a greener colour, spotted with black, and with two pale yellow lines down the back. Those however who collect the Frogs for the purpose of the table are known not to be very scrupulous in their choice, and it is acknowledged that not only Common Frogs but even Toads also are often intermixed with the green ones.

Such animals of this genus as are of a heavier or thicker form than the rest, with shorter limbs, and which rather crawl than spring, are called Toads. Of these the *Rana Bufo* or Common Toad is the principal European species. Its changes are similar to those of the Frog, but the eggs from which its tadpoles proceed are not deposited in the form of clustered heaps, but in that of long double strings, bearing the appearance of so many necklaces. The Common Toad



Amphib. europ.

is a perfectly innocent animal, and the tales relative to its supposed venom are now pretty well exploded. There are however some exotic species of Toad, which exsude a highly acrimonious and offensive moisture from their skin, and which is said to be of a corrosive or hurtful nature.

In South-America is produced a highly singular species of Toad, called the Pipa or Toad of Surinam. It is of large size, with a flattened and somewhat triangular head, and with all the toes of the fore-feet regularly divided into four parts at the tip; the hind-feet being widely webbed. The young are produced, not in the usual manner, but from numerous cells on the back of the animal. It appears however on accurate examination, that even there they have undergone the general change from the tadpole to the complete animal, several having been observed in the form of tadpoles in the cells themselves.

Before we leave the Frog tribe we should particularize what has been sometimes called the Frog-Fish of Surinam, and which was once supposed to change from a Frog to a Fish. It is no other than the Tadpole or first state of a species of South-American Frog, which, when first

arrived at its state of perfection, appears less than the Tadpole from which it was gradually formed. Nor is this peculiar to the Surinam Frog or *Rana paradoxa*, but takes place in some of the European animals of this genus, which are rather larger in the tadpole state than when first arrived at their perfect form, as in the species called the *R. alliacea* or alliaceous Toad, a native of Germany, and some other parts of Europe.

To the Frogs succeed the Lizard tribe, constituting the Linnæan genus *Lacerta*, and distinguished by having a lengthened body, four feet, and a tail. The Lizard tribe is extremely numerous, and contains many animals of vast size, as the Crocodiles and Alligators; and others very small, as the common Newts. For the convenience of zoological students the genus may be divided into assortments arranged according to the habit or general appearance of the species. First the Crocodiles, distinguished by very large and strong scales. The Guanas, commonly furnished with a serrated process along the back, and often by a pouch or flap under the throat. The Cordyles, with serrated or toothed scales. The Lizards emphatically so called, with smooth

COMMON CROCODILE.



bodies, and square plates beneath. The Chamaeleons, with granulated skin, a large head, long extensile tongue, and long cylindric tail. Geckos, with granulated skin, scattered over with tubercles, and lobated feet. Skinks, with a very smooth skin, and large fish-like scales. Salamanders or Newts, with soft skins, and which generally inhabit the water. And lastly the long or snake-shaped Lizards, with extremely short legs and very minute feet.

Of this vast tribe of animals those termed Crocodiles have in all ages been regarded as some of the most formidable animals of the warmer regions. They inhabit Asia and Africa, but seem to be most common in the latter, where they reside in large rivers, as the Nile and the Niger, preying chiefly on fish, but occasionally seizing on almost every animal which happens to be exposed to their rapacity. Their size is prodigious, specimens being often seen of twenty feet in length, and we have accounts of some which exceeded thirty feet. The general colour of the Common Crocodile, when arrived at full growth, is blackish olive above and yellowish white beneath. The armour with which the body is co-

vered may be numbered among the most elaborate pieces of Nature's mechanism: it is so strong as easily to repel a musket ball; but on the under parts of the body it is much weaker or thinner. The Crocodile is produced from an egg scarcely larger than that of a goose, and covered with a strong calcarious shell, like that of a bird. Of these eggs the female deposits a numerous brood in the sand, and the young, when hatched, immediately betake themselves to the water.

The Indian or Gangetic Crocodile is of at least equal size with the Nilotic, and is distinguished by its very long and narrow snout, and by having teeth almost double the number of those of the Nilotic species.

The Alligator or American Crocodile is more nearly allied to the Nilotic, but is supposed to be distinguished by two rising lines or crests along the upper part of the tail.

The Ceylonese Crocodile much resembles these, but has every scale on the upper parts furnished with a flat crest or elevation. Besides these species, two or three others may be pretty distinctly traced in the works of naturalists, though their precise specific characters cannot be



COMMON CHAMELEON.

See *Jacq's London* Published by G. Knapp, Fleet Street.

accurately investigated. The common Crocodile has been supposed by the ancients to move the upper jaw : this the most accurate of the modern observers have given up as a mistaken doctrine ; but a naturalist of the French school, Monsieur Geoffroy, has lately revived the ancient doctrine, and contends that this circumstance really takes place in the Nilotic Crocodile.

As farther examples of the Lizard tribe I shall only mention the Chamæleons and the Salamanders or Water-Newts. The common Chamæleon, a native of many of the warmer parts of the world, and particularly of Africa, has long been celebrated for its supposed power of changing its colour at pleasure according to the object on which it is placed. This is a vulgar error ; but it is true that the animal does every now and then change its colour in a surprising manner, from some particular causes not well understood. The general colour of the animal is a greyish or blueish green ; and this often becomes, in the space of a few moments, variegated with spots and patches of red, brown, yellow, and other shades. The size of the full-grown Chamæleon is sometimes nearly a foot, exclusive of the tail, which is at least of equal

length. The eyes are large and globular, with a very small opening in the skin, so that the ball of the eye can only be seen externally: the animal can direct one eye upwards and the other downwards at pleasure, so great is its command over these organs. The tongue is extremely long, extensile at pleasure, like that of a Woodpecker, and furnished at the end with a broad glutinous tip. With this it catches insects, darting the tongue upon them, and suddenly retracting it, like the quadrupeds of the genera of *Manis* and *Myrmecophaga*. The *Chamæleon* can support a very long abstinence, and will even bear to be confined many weeks together without any visible food, and hence the old notion of its living on air. The best figure of the *Chamæleon* is that given in Mr. Miller's miscellaneous plates of Natural History.

There are two or three other species of *Chamæleon* which have only been fully described of late years.

I proceed to the last division of the Lizards, containing the Salamanders, or Water-Newts. In their whole economy these Lizards are strongly allied to Frogs, inhabiting the water, and pro-

SALAMANDER.



Hell-brook.

(GREAT WATER-NIGHT)

ceeding from soft gelatinous eggs or spawn. The young, when first hatched, are furnished on each side the breast with a pair of ramified breathing-organs, which are obliterated when the animal is full-grown. The common Salamander, so famous for the old vulgar error which relates to its supposed power of living in the fire, is a beautiful animal of about eight or nine inches in length, and of a black colour, with large, irregular, deep-yellow spots and patches. It is a native of many parts of Germany in particular, and occasionally appears either on land or in water: on the upper part of the body it is furnished with a great many large pores, from which, on any irritation a whitish watery fluid exsudes, and this has given rise to the popular superstition of its being able to quench any fire into which it can be thrown.

The larger English-Newt or *L. palustris* of Linnæus much resembles it, but is smaller, and of a brown colour, with minute white specks, and varied with black and yellow beneath.

The common or smaller-Newt, the *L. aquatica* of Linnæus, is an inhabitant of every stagnant water, and is a very elegant animal, of a yellowish olive-brown colour, with numerous round black

spots; the under parts bright orange with larger and more irregular black spots. The male of this species is distinguished by a rising crest along the back, and by its broad finny tail, ending in a sharpened point. It is one of the most convenient subjects for exhibiting a general view of the circulation of the blood by the microscope.

Having thus given a general survey of the Lizards, I shall mention an animal of a somewhat dubious cast, and which has for many years been known to naturalists under the name of the *Siren*. It was first discovered by the late ingenious Dr. Garden, of Charlestown in South Carolina, who not being able to refer it to any known animal, sent a specimen to Linnæus for his opinion. Linnæus was so struck by the singularity of its appearance and its characters, that he instituted for it a new order of the amphibia under the title of *Meantes*. The *Siren* of Carolina has the general appearance of an Eel, as to size, but has on each side the neck a pair of ramified breathing-organs or branchiæ, resembling those of water lizards in their imperfect state: it has also two feet only, which are furnished with small claws. Some have been inclined to suppose this animal no other



THE JOURNAL OF THE

AMERICAN MEDICAL ASSOCIATION

PUBLISHED WEEKLY

CHICAGO, ILL., MAY 1, 1913

Vol. 10, No. 19

Published by the American Medical Association, 535 North Dearborn Street, Chicago, Ill.

Subscription price, \$5.00 per annum in advance.

Single copies, 15 cents.

Entered as second-class matter, May 1, 1913.

Postage paid at Chicago, Ill.

Acceptance for mailing at special rate of postage provided for in Act of October 3, 1917.

Postmaster: This publication is published weekly.

It is published by the American Medical Association, 535 North Dearborn Street, Chicago, Ill.

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than the larva or unadvanced state of some hitherto unknown species of Lizard; while others suppose it to be a truly perfect animal, and to constitute very properly a distinct genus. The celebrated Camper having from some mistake supposed it to be without lungs, referred it to the genus *Muræna* or Eel, considering it as a species of Eel differing from the rest in having ramified fins.

A second species of Siren is a native of Europe, and is only found in the celebrated lake called Lake Cernitz or Zitticher sea, in the dutchy of Carniola. It is somewhat more than a foot in length, and entirely of a pale rose-colour.

Other species of an equally dubious or uncertain cast have been discovered in different parts of the world, some of which are perhaps really the larvæ, or young of Lizards, while others seem truly to constitute a distinct genus like those I have just described.

Another very singular animal, which Linnæus considers as a distinct genus, is the *Draco* or Dragon, otherwise called the Flying-Lizard. It is a small Lizard with a very long tail, and with a wide expanded skin on each side the body, sup-

ported by internal ribs, and by the help of which it flies or flutters. It is a perfectly innocent animal, and is found in many parts of Asia and Africa. Its natural colour is a fine blueish grey, with darker variegations, and the wings are elegantly spotted towards their edges with black and white variegations. The animal is the *Draco volans* of Linnæus. Another species has been described by some, differing from the present in having the fore-legs joined to the upper part of the wings.

I shall proceed to take a very short survey of the Serpent tribe, constituting the last order of the Linnæan amphibia. The Serpents, in a general view, are readily distinguished from the rest by their total want of feet; moving by the assistance of their scales, and their general powers of contorsion. In the serpents the distinction of the species is often very difficult, the animals often varying greatly in colours according to the different stages of their growth. Linnæus imagined that he had discovered an infallible method of ascertaining the species, viz. from the number of scaly plates on the lower parts of the animal in the different genera; but experience has sufficiently proved this method to be erroneous, and

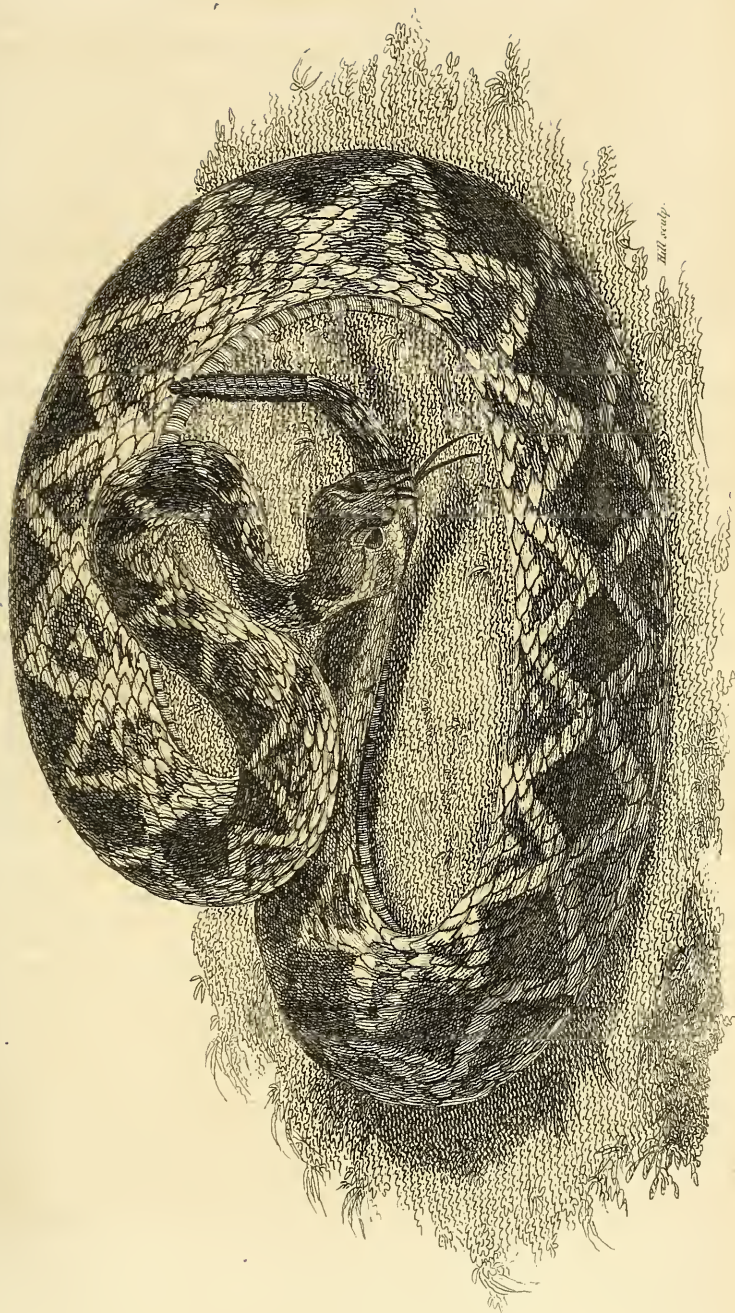
the general pattern or disposition of the colours is perhaps a more certain criterion, though confessed to be liable to alteration.

One of the most singular properties of the Serpent tribe is that of casting their skin from time to time. When this operation takes place, so complete is the spoil or cast-skin that even the external coat of the eyes themselves makes a part of it. The distinction of Serpents into poisonous and innoxious can only be known by an accurate inspection of the teeth; the fangs or poisonous teeth being always of a tubular structure, and furnished with a small hole or slit near the tip: they are rooted into a particular bone, so jointed to the remainder of the jaw on each side, as to permit the fangs or poisoning teeth to be raised or depressed at the pleasure of the animal. Above the root of each is a glandular reservoir of poison, which in the act of biting is pressed into the tube of the tooth, and discharged into the wound through the hole near the tip. The fangs are generally single on each side; sometimes double or treble, and in general there are small or young fangs situated at the base of the larger ones, ready to grow up and supply their place when lost by

accidental violence. But poisonous Serpents may often be at least guessed at, though not demonstrated, from the habit or general appearance of the animal, most of the venomous Serpents having rather large heads, covered with small scales, whereas those which are innocent have the head generally covered with large scaly plates; but on the other hand some highly venomous Serpents have the head covered with large scales also; so that no absolute mark of distinction can be found except the fangs. In general it may be said that innocent Serpents have four rows of teeth in the upper jaw; two on the palate and the rest on each side; but that poisonous Serpents have no other outward or side-teeth but the fangs.

The genera or particular sets of Serpents established by some modern naturalists are pretty numerous, and even unnecessarily so. Linnæus on the contrary established but few. His first genus is that of *Crotalus* or *Rattle Snake*. Its character is that beneath the body are broad scaly semi-circular transverse plates or shields; the same, together with some divided shields beneath the tail, and the tail itself terminated by a rattle, composed of many dry horny flattish organs of a peculiar

STRIPED RATTLE-SNAKE.



Hill engr.

EXHIBIT

The following is a list of the items
which have been received from the
various sources mentioned in the
report of the Committee on the
Administration of the
Department of the Interior
for the year ending June 30, 1891.
The items are classified under
the following heads:
1. Land and Water.
2. Minerals.
3. Forests.
4. Public Buildings.
5. Miscellaneous.
The total value of the items
received is \$1,000,000.
The items are as follows:
1. Land and Water.
2. Minerals.
3. Forests.
4. Public Buildings.
5. Miscellaneous.

shape, growing over each other, and so constituted as to give a strong rattling sound when the animal shakes them, which it never fails to do when irritated or disturbed, and may thus be said to warn other animals of their danger in making too near an approach. The common Rattle-Snake (for there are several different species) is naturally a slow-moving animal, and therefore all the tales that are told of its darting with the rapidity of lightning about its native woods and plains, must be considered as mere imaginary description. The Count de Ceppe in his history of the Rattle-Snake commences with a Buffonian flourish of this kind, and assures us that "the traveller wandering in the midst of the burning solitudes of Africa, and fainting under the midday heat, feels not a more thrilling horror on hearing at a distance the tremendous voice of the Tyger roaring for his prey, than he who passing through the moist forests of the new world experiences, when in the midst of beauty and fragrance he is on a sudden surprized by the sound of the Rattle-Snake, ready to dart upon him in order to destroy him." The Rattle-Snake on the contrary, according to the united testimony of all real observers, never attacks or

moves towards a person who approaches him, but always endeavours to escape, and never bites unless accidentally trodden on or purposely irritated. The colour of the Rattle-Snake is brown with yellow variegations; in one species these are in the form of bars, and in another in the form of Lozenge-shaped streaks: it grows to the length of some feet. Its bite is certainly one of the most dangerous of the whole Serpent tribe; but its effect, like that of every other poisonous Serpent, must vary extremely according to the state of health of the person receiving the wound, as well as of the part on which the wound has been inflicted: if it happens on a large vein, it very soon proves fatal: if not, it is often curable. We have well attested accounts of a dog's having been killed in less than two minutes by the bite of a Rattle-Snake*.

The next Linnæan genus of Snakes is called *Boa*, and is distinguished by having broad scaly transverse plates both beneath the body and tail,

* The fascination of the R. Snake is now pretty generally referred either to the mere effects of fear, or to the supposed fascinated animals having been first in reality bitten and disabled from making their escape.



Hill sculp.

CONSTRUCTOR BOA.

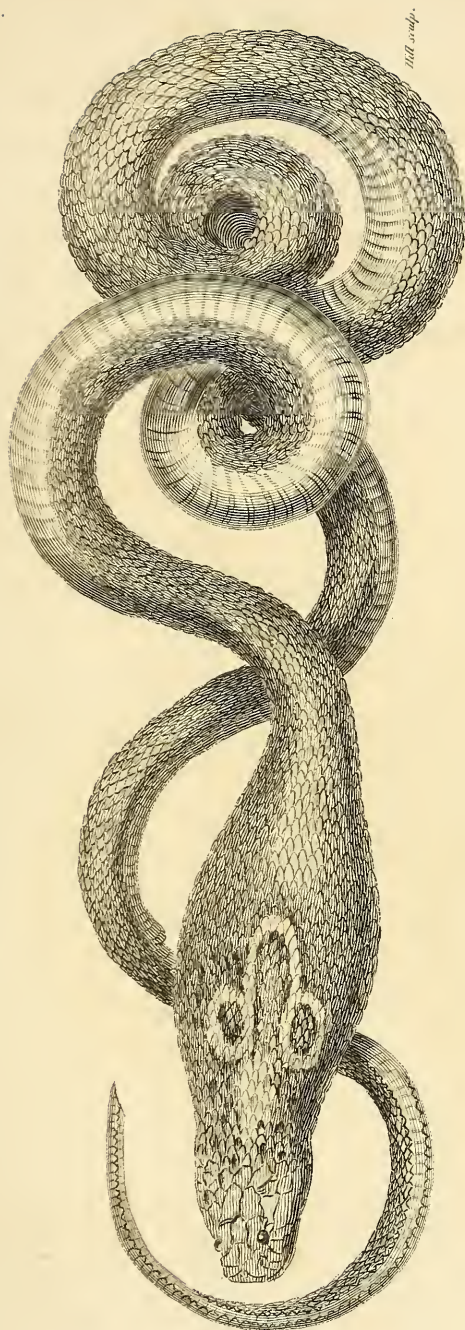
but without any rattle. Very few of this genus are poisonous, but some of them are remarkable for their enormous size; in particular a species found in Africa and called the *Boa Constrictor*, which grows to the length of thirty-five feet, and is said to destroy even Deer and Antelopes, by writhing itself round their bodies, so as to break or crush their bones, and then swallowing them very gradually, for all Serpents are capable, from the particular organization of their jaws, of swallowing animals of much greater diameter than their own bodies.

This is supposed to be the species which terrified the army of Regulus near the river Bagrada in Africa, and which is said to have measured 120 feet in length. This perhaps was an exaggeration. In the British Museum is a skin measuring thirty-five feet, and it is probable that many ages ago much larger specimens might have occurred than any at present to be found, the increased population and cultivation of most countries having tended more and more to lessen the number of such animals. Some of the Boæ are remarkable for the elegance of their colours and the beautiful disposition of their pattern.

The most numerous of all the Linnæan genera of Serpents is that of *Coluber*. It contains a mixture of poisonous and harmless Snakes: and is distinguished by having the under part of the body as far as the tail furnished with broad undivided plates, while the under part of the tail is covered with divided ones. Of the poisonous animals of the genus *Coluber*, one of the most remarkable is the *C. Naja* or Cobra de Capello, a native of many parts of India, and not less poisonous than the Rattle-Snake in America; its colour is commonly a dull yellow, and it has the power, when irritated, of dilating to a great extent the skin of the neck, into the form of a large flattened oval; this part is marked above by a very large patch resembling a pair of spectacles, and of a black colour edged with white. There appear to be many varieties of this Snake in India*.

Among the innocent species of *Coluber* the common English Snake may be mentioned as an example; a perfectly inoffensive animal, and which may even be tamed and rendered domestic.

* The common Viper is the only poisonous Snake of this genus in our own country.



SPECTACLE SNAKE.



GREATER HYDROT.

Hydrotus

The genus *Anguis* is distinguished by being uniformly covered with scales of a similar form in all parts, and commonly with very small scales. The common English Slowworm, the *Anguis Fragilis* of Linnæus, is an example of this genus, and is perfectly innocent, though vulgar prejudice still imagines its bite to be fatal. Many of the Indian and American Serpents of this genus are highly beautiful animals.

The genus called *Amphisbæna* is distinguished by having the body surrounded by complete rings of small square scales. The species are very few, and are perfectly innocent.

Lastly the genus *Cacilia* is characterized by being only marked along the sides by a kind of semicircular wrinkles. These Serpents are also innocent.

I have before observed that the genera of Serpents have been lately increased by the formation of some new ones. Of these I shall only mention the genus *Hydrus* or Water-Snake, a true and proper genus, and easily distinguished by the flattened form of the tail, which is in some species compressed vertically; in others horizontally. In point of general appearance these Snakes resemble

the genus *Anguis*. They are all natives of the waters, and are mostly found about the coasts of the southern islands and those of India and the Indian islands. Some species are poisonous, being furnished with tubular fangs, and others are harmless.

LECTURE VIII.

THE course of our Zoological investigations has now led us to a very extensive tribe of Animals, distinguished by the title of Fishes. Like the Amphibious animals their heart, in the language of anatomists, is unilocular, or consists but of one chief cavity, and their blood is far less warm than that of the higher order of animals, as quadrupeds and birds: the red particles of their blood are also of an oval shape. The organs of breathing in Fishes, analogous to the lungs in quadrupeds and birds, are distinguished by the name of gills, and consist of a vast number of ramifications of blood-vessels, curiously disposed in rows, and supported on a certain number of bony arches, generally four, on each side the breast. By the gills the air contained in the waters they inhabit, is supposed to afford oxygen to the blood in its passage through the very delicate ramifications of the blood-vessels on the gills; so that the same pro-

cess of nature, which in the higher orders of animals takes place in the internal cavity of the lungs, is brought about in Fishes externally by means of the subdivided branchings of the gills. These important organs the gills, are secured externally by a strong bony flap on each side, called the gill-cover, and which is generally edged with a thin membrane, capable of extension or contraction by means of a certain number of elastic arches with which it is internally furnished. The form of the body varies greatly in the different tribes: it must be almost unnecessary to add, that the most common or general shape is that of an oval, more or less contracted or sharpened at each extremity, and slightly compressed on each side. There is one tribe or order of Fishes in which the gills differ in their structure from the rest, and in some particular kinds have an appearance approaching to that of a kind of hollow lungs, while in others, certain organs situated near the gills bear an appearance resembling lungs, and these particularities of structure so much influenced the mind of Linnæus, that he placed most of the Fishes of this particular tribe, or what are generally termed the Cartilaginous Fishes, among the

Amphibia; imagining them to be possessed of a kind of real lungs as well as of gills.

The more accurate researches of modern naturalists have proved the mistake, and sufficiently explained its causes, and such Fishes are again remanded to their proper situation.

The generality of Fishes are covered with scales, of very various form and size in the different tribes, and even many fishes which are popularly supposed to be perfectly destitute of scales, are found, on an accurate inspection, to be furnished with them, as the common Eel, for example. The scales in Fishes are to be considered as analogous to the hair, or spines, or scales in the different kinds of quadrupeds, as well as to the feathers of birds, the animal matter of which they consist being nearly the same in all.

The chief instruments of motion in Fishes are the fins, which may be considered as analogous to the limbs in quadrupeds: they consist of a certain number of elastic rays or processes, either of one single piece, in the form of a spine, or of jointed and subdivided pieces, ramifying towards the extremity: the strong or spiny rays are usually placed at the fore-part of the fin, and the soft or

jointed rays towards the back-part. By the various flexure therefore of these organs, the movements of Fishes are conducted; the perpendicular fins, situated on the back or upper part of the animal, keeping the body in equilibrio, while the tail, which is also perpendicular in its direction, and capable of various flexures and contractions, operates as a rudder at the stern of a vessel, and the side or breast-fins as oars.

With respect to the internal parts of Fishes, it is observed that the throat is short; the stomach large, and the intestines far shorter than in quadrupeds and birds: the liver very large, and usually placed on the left side. In the majority of Fishes occurs under various shapes, a highly curious and important organ called the air-bladder or swimming-bladder: it generally lies close beneath the back-bone, and is provided with a very strong muscular coat, which gives it the power of contracting at the pleasure of the Fish, so as to condense the contained gas or elastic air with which it is filled, and thus enable the animal to descend to any depth, and again to ascend by being restored to its largest size. In some Fishes it is found to communicate with the throat; in

others with the stomach. Some Fishes are totally destitute of the air-bladder, and such Fishes are observed to remain always at the bottom, as the whole tribe of what are termed flat-Fish. If in such Fishes as are provided with an air-bladder, that organ be punctured, so as to let out its contained gas or particular aerial fluid, the Fish is unable to rise afterwards, but is obliged to remain continually at the bottom*.

The teeth in Fish are extremely various in the different tribes, in some very large and strong, in others very small; in some sharp, in others obtuse; in some very numerous, and in others very few. Sometimes they are placed in the jaws, sometimes in the palate or the tongue, or even at the entrance of the stomach. The eyes are in general large, and very much flattened, or far less convex than in quadrupeds and birds; this structure being better calculated for giving them an easy passage through the water they inhabit: in return, the central part of the eye, or what is

* It is observed by Cuvier, that some Fishes having remained for a considerable time near the surface of the water, under a hot Sun, have had their air-bladder so dilated by the heat communicated to its contained gas, as to be unable suddenly to compress it sufficiently to permit themselves to descend.

called the crystalline humour, is of a round or globular shape, in order to give the animal the necessary power of vision, and to compensate for the comparative flatness of the cornea.

The organ of smelling in fishes is large, and the animals have the power of contracting or dilating the passage to it at pleasure. Their smell is supposed to be extremely acute.

It was formerly much doubted whether fishes possessed the sense of hearing, having no external ear: the accurate researches of modern anatomists have however clearly evinced that the organ of hearing, though differing in some particulars from that of other animals, does yet exist; and is only modified according to the different nature of the animals. Indeed although the nature of the organ of hearing in fishes was not accurately known to the older anatomists, yet it was plain that fishes did hear; as was evident from a practice common in many parts of Europe of calling Carp and other fishes to their feeding-place by the sound of a bell; a signal which the animals readily obey. The particular structure of the Ear in fishes may be found amply explained in the works of *Monro*, *Cuvier*, *Camper*, and other modern anatomists.

Of voice, properly so called, fishes are en-

tirely destitute, the particular kind of stridulous sound which some kinds are observed to produce on being first taken out of the water, being entirely owing to the sudden expulsion of air from their internal cavities, as in the Gurnards or Pipers, and some other fishes.

By far the greater number of fishes are oviparous, producing soft eggs, usually known by the name of spawn. Some fishes are however viviparous, the eggs first hatching internally. Fishes may certainly be considered as the most prolific of all animals: many millions often proceeding from a single individual. The gradual evolution of the young from the egg is highly curious. In the spawn of the Barbel and some others, which usually hatches in the space of about nine or ten days, on the second day may be perceived in each egg a small dusky speck between the white and the yolk: on the third day the motion or pulsation of the heart becomes visible, and the body may be perceived, adhering laterally to the yolk: on the 6th day the back-bone and ribs are perceptible; on the 7th day the eyes; and the animal begins to move itself briskly from time to time, till at length, on the 9th or 10th day it bursts from

its confinement. During the first six or eight hours from its birth, it is observed to grow nearly as much in proportion as in fifteen or twenty days afterwards. In the young animal before it has left the egg, the pulsations or beatings of the heart amount to about forty in a minute; but immediately after hatching, they are increased to the number of sixty in a minute. Young fish, in this very diminutive state, are so transparent as to exhibit with great distinctness the course even of their larger blood-vessels. In the work of Dr. Bloch we find a good representation of a fish in this state, viz. the Common Barbel.

The age of fish is, according to Linnæus, determinable from the number of concentric circles of the vertebræ or joints of the back-bone, in the same manner as that of trees is supposed to be from the concentric circles of the wood. Leewenhoeck used to imagine that the age of fish might be determined from the concentric circles or fibres of the scales; but perhaps it may admit of much doubt whether either of these opinions be true.

After this general survey of fishes as a tribe,

I shall proceed to give a view of the Linnæan arrangement of the different kinds of Fishes. In order to understand this we must observe that the under or belly fins, called by Linnæus the ventral fins, are to be considered as analogous to the feet in quadrupeds; and it is from the situation, presence or absence of these fins that the Linnæan divisions of fishes are instituted.

Such fishes as are entirely destitute of ventral fins are termed apodal or footless fishes, and these form the first Linnæan order. Those which have the ventral or belly-fins placed more forward than the pectoral or breast-fins, are termed jugular fishes, and form the second Linnæan division. Those which have the ventral fins situated directly or immediately beneath the breast fins are called thoracic fishes, and constitute the third Linnæan division; and lastly those which have the ventral fins situated beyond or behind the breast or pectoral fins are termed abdominal fishes, and form the fourth Linnæan division.

There still remains a particular tribe called cartilaginous fishes. This is the tribe which Linnæus improperly admitted among his amphibia, on a supposition of their being furnished with lungs

as well as with branchiæ or ramified gills. This division differs from all the rest of the fish tribe in having a cartilaginous instead of a bony skeleton, and in being destitute of ribs. It consists of the Lampreys, the Rays, the Sharks and a variety of other fishes, and will be particularized after our survey of the Linnæan fishes, or such as have a bony skeleton, furnished with ribs.

In passing through these I shall select a genus or two of each division as an example, and particularize a few of the leading or principal species.

Of the first division or the apodal or footless fishes, in which the ventral or belly fins are wanting, the genus *Muræna* or Eel is one of the principal. The Eels are distinguished by their long cylindric smooth body with a shallow back-fin, uniting with that of the tail into a continued border; tubular nostrils, and eyes covered by the common or general skin, which is transparent in those parts. The Common Eel, which is so well known as scarcely to require a particular description, is a very general inhabitant of almost all parts of the ancient continent, varying in size and colours according to the nature of the waters in which it is found. I have before observed that it

COMMON EEL.



CONGER EEL.

Anguilla vulgaris

is vulgarly reputed a scaleless fish, but though the scales on a general view are not conspicuous, on account of the slime with which they are covered, yet when the skin is well wiped and dried they are easily visible, and are of a lengthened oval form, of a whitish colour, and exhibit a very elegant texture when examined by the microscope. They have long ago been well described and figured in the works of the celebrated Leewenhoeck.

The Conger or Sea-Eel (*Muræna Conger* of Linnæus) so much resembles the Eel in its general appearance that it has often been considered rather as a variety than truly distinct. It is however of a much larger size, of a blacker or darker colour, and is commonly marked along the sides by a row of white specks. It is likewise an inhabitant of the sea, and is only an occasional visitant of fresh waters. Both the Eel and the Conger are viviparous; producing their young, which are very numerous during the decline of summer. The young are at first very small.

A very celebrated species of this genus is the *Muræna* of the ancient Romans, who considered it as one of the most luxurious articles of the table, and sometimes kept it in reservoirs, where it was

occasionally tamed to such a degree as to come at the signal of its master in order to receive its food. Its size is at least equal, if not superior to that of the Common Eel, and its colour a dusky greenish brown, pretty thickly variegated on all parts with somewhat angular marks and patches of dull yellow, which are scattered over with dusky specks. I almost hesitate to relate the disgusting instance of barbarous cruelty practised, according to Pliny, by a Roman of distinction of the name of Vedius Pollio, who was in the habit of causing such of his slaves as had offended him to be thrown into his reservoirs in order to feed his *Murænæ*, expressing a savage delight in thus being able to taste in an improved state their altered remains. The Emperor Augustus honoured this man with his presence at one of his entertainments; when a young slave happening to break a crystal goblet, was immediately ordered to be thrown to the *Murænæ*. The boy however, flying to the feet of the Emperor and explaining the secret, Augustus was so shocked at this instance of cruelty, that he immediately ordered all the crystal vessels in the house to be broken before his face, and the ponds of the owner to be filled up; giving the boy his

MURÆNA

*Eglynæ sculp.*

freedom, and bestowing an unmerited pardon on the offender ; sparing his life in consideration of former friendship. This story has been so often related that it cannot be supposed to be impressive to many from its novelty, but many authors make a mistake as to the *Fish*, which instead of a *Muræna* they erroneously suppose to be a Lamprey. The Eels strictly speaking, are furnished with pectoral or breast-fins ; but the *Murænæ* have none. Authors therefore who are partial to a highly precise division of the genera of fishes, instead of comprehending the Eels and the *Murænæ* under the common title of *Muræna*, as Linnæus has done, divide them into distinct genera under the titles of *Muræna*, *Anguilla*, *Synbranchus*, and some others ; all agreeing in general form, but distinguished from each other by the absence or presence of breast-fins and some other circumstances.

A more remarkable genus of apodal or footless fishes is that of *Gymnotus*, which is distinguished by a lengthened body, without any back-fin, but furnished with one beneath, running along almost from extent or length of the animal. The principal species is the *Gymnotus electricus* or Electrical *Gymnotus*, sometimes improperly termed the

Electric Eel. It is an animal of an unpleasant appearance, bearing a general resemblance to a very large Eel, but thicker in proportion, and is generally of a very dark blackish brown colour. The length of such specimens as have been brought into Europe have hardly exceeded three or four feet, but in its native regions of South-America, and particularly in the river Surinam in the province of that name, it is said to arrive at the length of seven, ten, or even fifteen feet. It was first made known to the Philosophers of Europe about the year 1671, when its wonderful properties were described to the French academy by a Dr. Richer, one of those sent out by the academy to conduct some mathematical observations at Cayenne. The fish possesses the highest possible degree of natural electricity or galvanism, so that when touched it communicates a very powerful electric shock; so powerful indeed that it is affirmed to be sometimes fatal to incautious swimmers who happen to encounter it in its native waters. By this electric power it supports its life; suddenly stupifying such smaller fishes or other animals on which it preys, and then devouring them. To those who may wish for a more

ELECTRIC GYMNOTUS



ample detail both of the animal itself and its extraordinary powers, I must recommend the description by Dr. Garden in the Philosophical Transactions, and the highly accurate anatomical survey of the animal by the late Mr. John Hunter in the same work.

After these examples of the first tribe or apodal fishes, I shall proceed to those which Linnæus terms *Jugular*, as having the ventral or belly-fins placed before the pectoral or breast-fins.

Of this division the genus called *Trachinus*, or Weever, may afford an example. It is characterized by having a compressed body, the gill-covers serrated or toothed on their edges, and terminated by a spine; and a small fin situated on the top of the back, almost immediately beyond the head. The most common species or *T. Draco*, of Linnæus is a native of the European seas, and is sufficiently common about our own coasts. It usually measures about a foot in length, and is of a yellowish silvery colour; with the small or first back-fin before mentioned of a black colour, and furnished with four or five strong spines or rays. With this fin it wounds such as attempt to seize it, by suddenly throwing itself back, and infix-

ing the spines of its fin ; and so painful is the wound, that a general belief still prevails of its being accompanied by a kind of poison ; but it is certain that the spines of the fin are not tubular, nor is any fish known to contain any real or proper poisonous fluid ; though several become poisonous by feeding on acrimonious substances, and being eaten without proper precautions.

To the jugular fishes belongs a numerous genus entitled *Gadus* or Codfish, containing not only the Common Codfish, but the Haddock, the Ling, the Burbot, and a great variety of others. The chief character of this genus is that the ventral fins are slender, and terminate in a point, and that the back-fins are two or three in number. The Common Codfish is a native of the northern seas, where it resides in immense shoals, and performs various migrations at stated seasons, visiting in succession the different coasts both of Europe and America. The chief fishery is about the sand-banks of Newfoundland, which are described as constituting a vast submarine mountain of above five hundred miles long, and near three hundred broad. Our own country enjoys the greatest share of this fishery, which is carried on

by the hook and line only, the principal baits, according to Mr. Pennant, being Herring, pieces of Sea-fowl, and the shell-fish called Clams, and with these are caught fish sufficient to find employment for fifteen thousand British seamen, and to afford subsistence to a much more numerous body of people at home, who are engaged in the various manufactures which so vast a fishery demands. The fish, when taken, are properly cleaned and dried, and in this state are sent into every part of the European continent. The fishermen are well acquainted with the use of the air-bladder in this fish, which is usually called the sound; and when the fish is first taken, they contrive to perforate the sound or air-bladder with a long needle, in order to let out its contained air, by which means the fish is effectually kept under water in their well-boats, and thus brought fresh to the place of sale.

The third Linnæan division or the Thoracic tribe is extremely numerous: in this division the ventral fins are situated immediately beneath the pectoral ones. Among the most remarkable genera may be reckoned the lately instituted one

of *Gymnetrus*, distinguished by its very long, compressed body, numerous, small, slender teeth, and very long, slender ventral fins or processes. One of the most remarkable species is that which has been named the Russelian *Gymnetrus*, from the late Dr. Patrick Russel: it was of a silvery colour, and is represented on the plate we are now viewing in its natural size, and was probably a young specimen from its want of visible teeth. The same animal in its complete or advanced state appears from the description of Professor Ascanius and others to measure not less than ten feet in length, with a strongly marked lateral line, and a few rows of dusky spots across the body. It is a native of the Northern and Indian seas, and is popularly called the King of the Herrings.

Another species is the Hawkenian *Gymnetrus*, or Blochian *Gymnetrus*; in its general appearance much allied to the former, but differing in colour, having the fins of a bright red, and the body clouded with blueish bands. A specimen measuring six feet in length and about ten inches in breadth, was taken on the coast of Cornwall.

This has been published under the title of the Comet-Fish; I suppose from the infrequency of its appearance.

This genus is not a Linnæan one, and was first described by Ascanius, under the name of *Regalecus*.

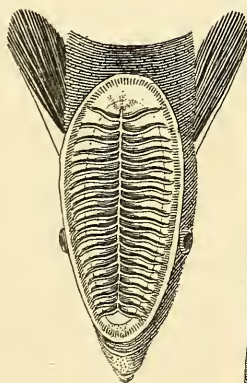
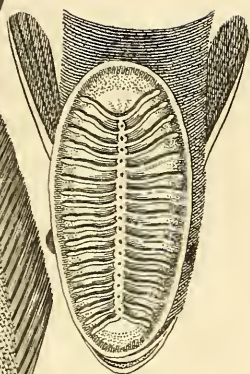
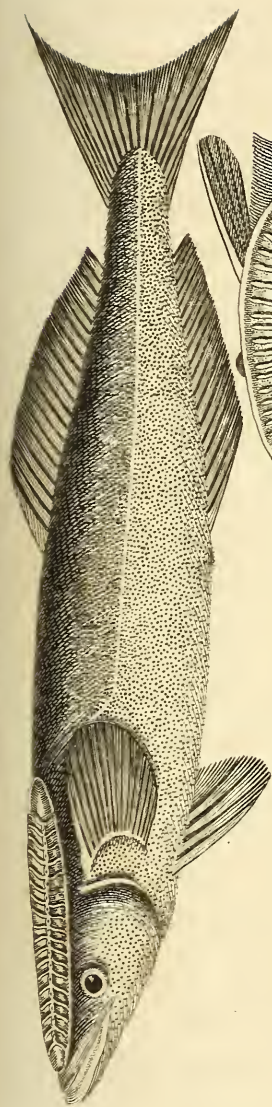
The beautiful genus *Coryphæna* or Coryphene, improperly called Dolphin by sailors, consists in general of rather large Fishes, of a lengthened shape, with a large and very sloping head, and in general of beautiful colours. The *common Coryphene* in particular, is a Fish of extreme beauty of colour, being of a rich and bright blue-green, with numerous orange-coloured specks. It measures about three feet in length, and is an inhabitant of the Indian and Atlantic seas, often appearing in large shoals, and sometimes following ships in order to obtain any occasional articles of food which may happen to be thrown overboard. When taken out of the water its beauty of colour gradually fades as the Fish expires; the lustre vanishing by degrees, with partial restorations, till at length it becomes of a dull greyish or cinereous cast, without any remains of its former splendor. This gradual evanescence of colour in the dying

Coryphene is contemplated by sailors with as much delight as the ancient Romans are said to have exhibited on viewing similar changes in the expiring Mullet, when brought to their tables before the feast began.

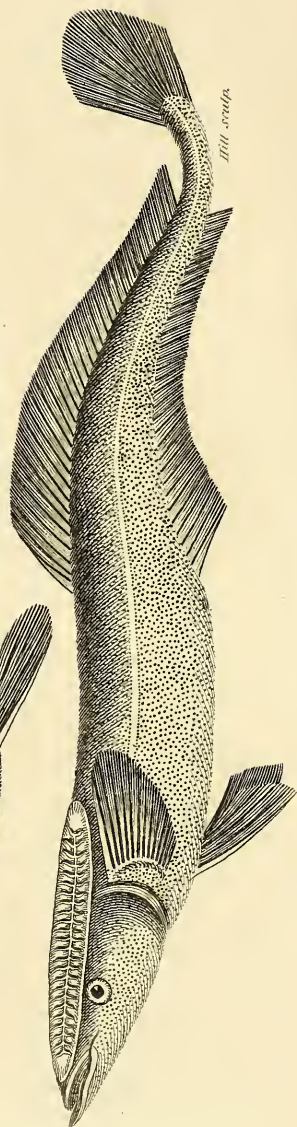
Among the smallest Fishes of this genus is the *C. Novacula* or Razor Coryphene, so named on account of its extreme thinness of body: it is of a reddish-yellow colour, varied in some parts with blue lines and spots.

The genus *Echeneis* or Remora is a highly singular one, and is readily distinguished by the very remarkable structure of the head, which is flattened on the top into the form of an oval space, divided down the middle, and crossed by very numerous partitions, beset on the edges with small fibres. By this part the Fishes of this genus are enabled to adhere with the utmost tenacity to any moderately flat surface, and thus frequently affix themselves either to the sides of ships, or to Sharks and many other of the larger Fishes.

The ancients imagined that these Fishes possessed the power of stopping a vessel in full sail by thus adhering to it, and rendering it immove-



INDIAN REMORA.

*Hill sculp.*

able in the midst of the sea. The adhesion however of a number of these Fishes at once to the side of a small canoe, in the earlier ages of mankind, may really be supposed to have considerably retarded its progress, and have even caused it to incline on one side; and the tale once related, might have gradually grown into the exaggerated powers afterwards ascribed to the animal. The real fact is, that the *Remora* being a Fish of very weak powers of fin, takes the advantage of occasionally attaching itself to any large swimming body, whether animate or inanimate, which it happens to meet with; for when left to its own exertions it swims weakly, unsteadily, and often on its back. It is therefore necessary that it should avail itself of the occasional assistance of some larger floating body, and for this purpose the wonderful structure of the head is formed. The common *Remora* or *E. Remora* of Linnæus is a native of the Mediterranean sea, and is of a brown colour, with about eighteen bars across the sucker on the head.

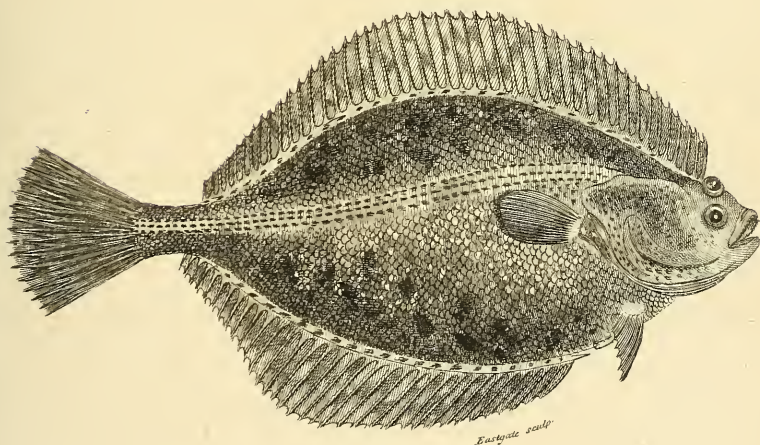
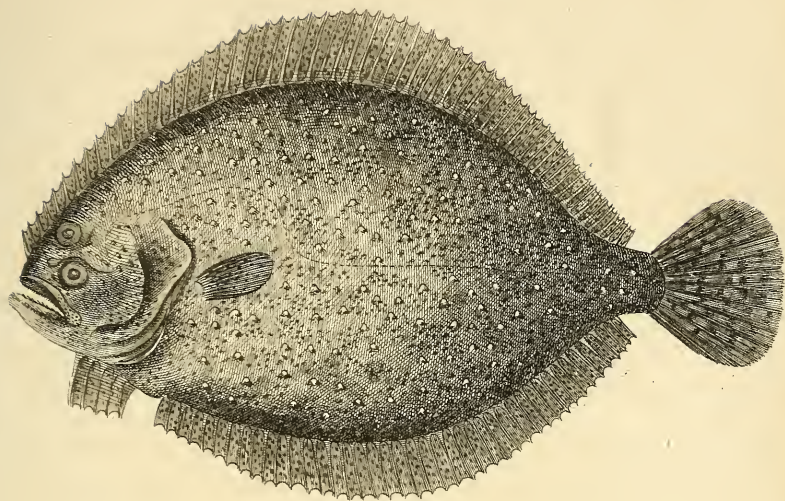
Another species, called the Indian *Remora*, is of an olive-green colour, with 24 bars across the sucker. A third species has been discovered in

the Pacific Ocean, which is smaller than the others, and has ten bars only across the head.

Of the whole tribe of Fishes, few are more remarkable than the genus *Pleuronectes*, which contains the different kinds of Flounders, Turbots, Soles and other Fishes of similar kind. In this genus nature exhibits a most extraordinary deviation from her usual plan in the formation of animals: the two sides in this genus representing an upper and under surface, one appearing at first view to be the back, and the other the belly of the Fish. The eyes are placed on one side only, and the animal generally swims, not in the manner of other Fishes, but sideways, or with the coloured surface upwards and the pale one downwards. In order to facilitate the investigation of this numerous genus, Linnæus divides them into such as have the eyes looking either to the left or the right. If a Fish of this nature be laid with its coloured side upwards, and its belly towards the observer, then if the eyes are on the right hand, it belongs to the division *Oculis dextris* of Linnæus: if on the contrary the eyes are on the left hand, it then must be sought for in the left handed division of the genus, or among those, in the Linnæan phrase,

TURBOT

10



FLOUNDER

LANCET ACANTHURUS

*Engraved by*

Oculis sinistris. It is owing to a want of attention to this circumstance that so many errors have crept into works of natural history, relative to the Fishes of this genus; for if the engraver is not careful to reverse the drawing, it will give the species in a wrong division of the genus. I cannot acquit the artists employed in my own works of some inattention in this respect. Of the species with the eyes to the right the common *Flounder* furnishes a good example, and of those with eyes to the left the *Turbot*.

The numerous genus *Chætodon* is remarkable for the peculiar elegance and variety of its colours in the different species, which are often disposed in the form of bands or zones, either transverse or longitudinal. Most of these Fishes are natives of the Indian and American seas. Their teeth are small, very numerous, close-set, and resemble so many bristles.

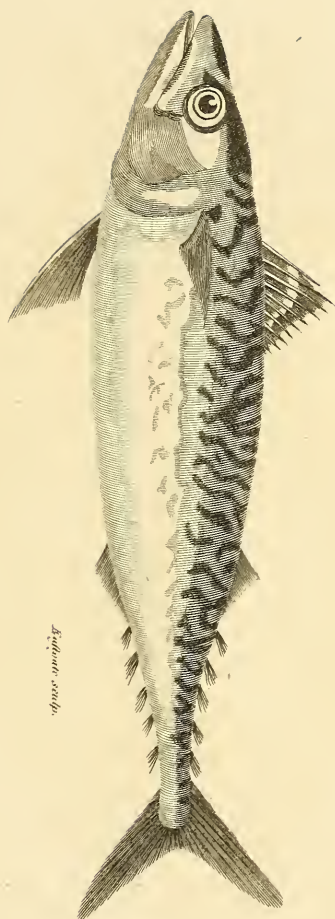
Another genus, greatly allied to *Chætodon*, and one intermixed with it, differs in having strong and broad teeth, and a very strong upright spine on each side the base of the tail. It is a lately instituted genus, and is called *Acanthurus*, or Thorn-Tail.

Among the Thoracic Fishes rank all the kinds of *Perches*, forming the Linnæan genus *Perca*. They have sharp teeth, scaly and serrated gill-covers, and a back-fin with the fore-part furnished with spiny rays, and the back part with soft ones; and the scales in most species are hard and rough. The common Perch is an elegant fish, of an olive brown, marked by five or six dusky transverse bars, and is found in most parts of Europe.

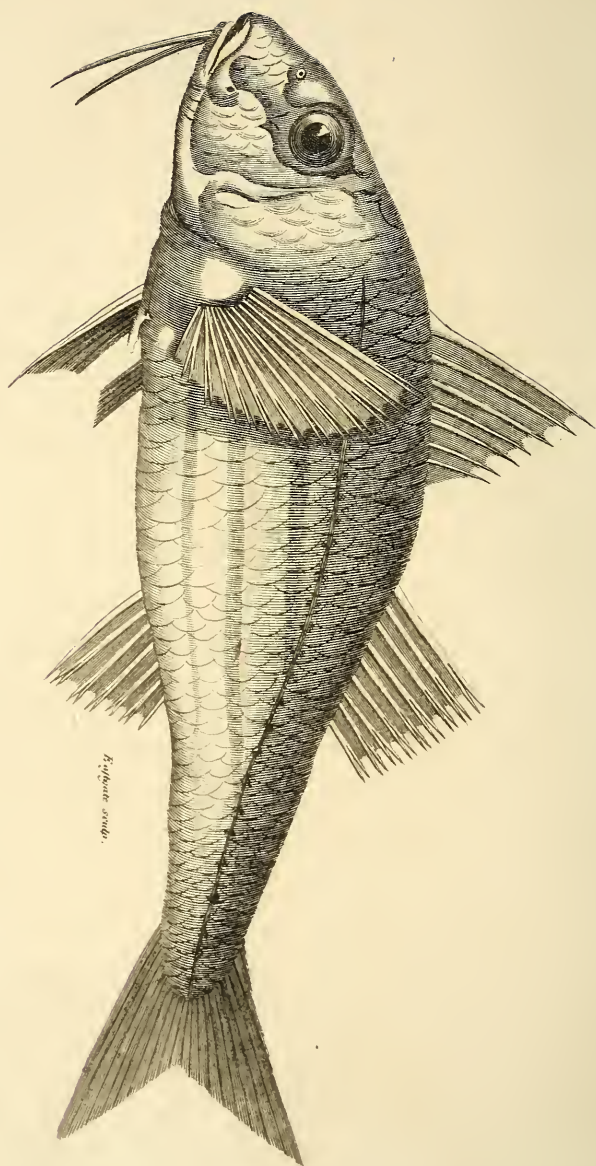
Very strongly allied to the genus *Perca* are the several lately instituted genera of *Holocentrus* *Sciæna* and some others.

The Fishes of the Mackrel tribe belong to a genus called *Scomber*, and are distinguished by their oblong body, furnished above and below the back-part near the tail, with several small or spurious fins: in some species also the lateral line or middle longitudinal division of the Fish is furnished with a series of strong and broad scales. The common Mackrel is universally known, and is certainly one of the most beautiful of the European Fishes. Its celebrated migrations, so well detailed in the entertaining work of Mr. Pennant, begin now to be greatly called in question, and it is rather supposed that the glittering myriads

COMMON MACKEREL.

*Scomber scombrus*

SIRRIE

*R. g. g. g. g.*

which appear on the surface of our seas during the vernal season, were in reality at no great distance during the severity of winter, having only quitted the deep retreats of the ocean for the shallower parts near the shores, where they hasten at that season of the year in order to deposit their spawn.

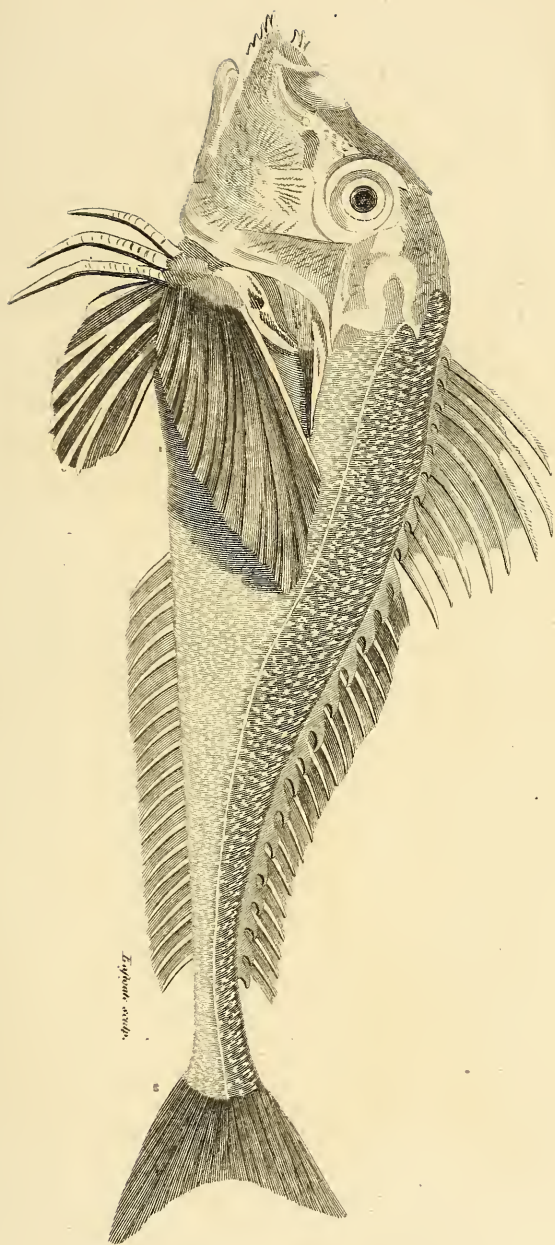
The genus *Mullus* or Mullet consists of Fishes distinguished by a pair of very long barbs or soft processes at the tip of the lower jaw. One of the principal species is the red Mullet or the Surmullet, the favourite luxury of the ancient Romans, who gave the most extravagant sums for it, and had it brought to table in a glass vessel, before the feast began, in order that the guests might contemplate the elegant changes of its colour during the minutes of its expiration; the natural rosy red, exhibiting at that time the most beautiful flushings and alternate paleness, till at length all fades into a dull grey.

The concluding genus of the Thoracic Fishes is that of *Trigla*, containing the Gurnards: they are distinguished by a large head, roughed with sharp lines, and have spiny gill-covers. Of this

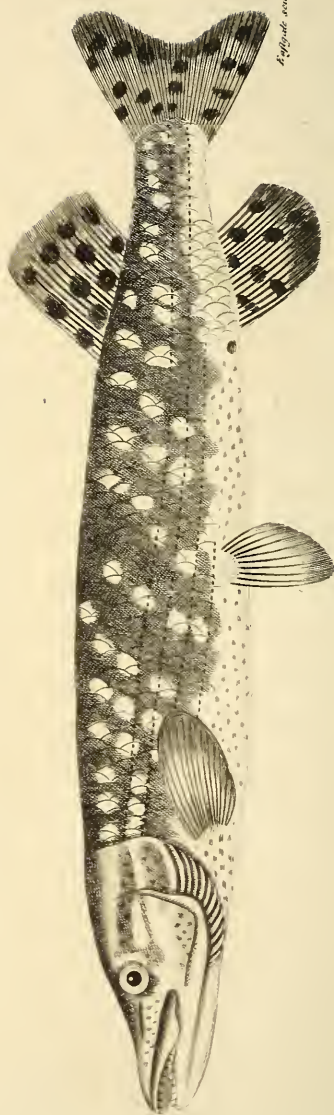
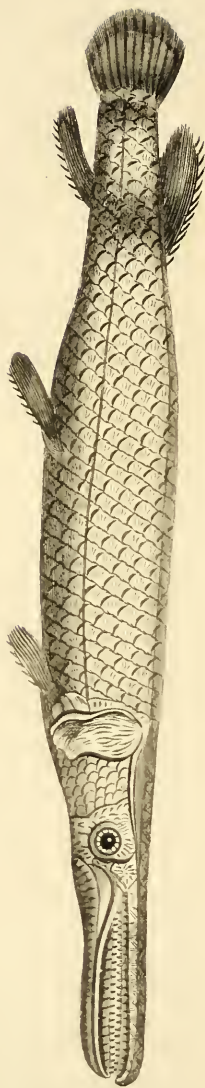
genus is the fish called the Piper, of a red colour, and celebrated for its excellency as an article of food. But the most remarkable species is the Flying Gurnard, which is of a reddish colour, with very strong scales, and the pectoral fins so very large as to represent a kind of wings, and to enable the animal to use them occasionally in the manner of the flying-Fishes emphatically so called: these broad pectoral fins are also remarkable for the beauty of their colour, being of a fine oblique green, with numerous sapphire-coloured spots.

The last Linnæan division consists of the *Abdominal Fishes*, or those in which the ventral fins are placed beyond the pectoral ones. This order contains many very curious and interesting genera, of which, however, I shall only particularize a very few, as clear exemplifications of the order. Of these one of the most important is the genus *Salmo*, comprising all the Salmon and Trout race: a numerous tribe, distinguished by having a smooth and somewhat lengthened body, with the hind part furnished above with a small fatty fin without any rays. The tongue is cartilaginous, and often beset with teeth as well as the jaws.

PIPEF

*Trigloporus aratus*

EUROPEAN PKE



COMMON PKE

The common Salmon is the *S. Salar* of Linnaeus, and is an inhabitant of the northern regions, where it occurs at different periods both in salt and fresh waters, quitting the sea, at certain periods, in order to deposit its spawn in the gravelly beds of clear rivers. At this particular period hardly any obstacles are able to overcome the impetuosity of the Salmon intent on forcing their way up the stream; and they are known to spring up occasionally in such a manner as to pass cataracts of many feet in height. Like the Swallow, the Salmon visits the self-same spot each season; as has been ascertained by the experiment of fastening a small ring to the tails of some individuals, and then setting them at liberty, when they have made their appearance at the same spot, for three successive seasons. The male Salmon is distinguished by its strongly curved or hooked jaws.

The Trout, the Grayling, the Char, and a multitude of other Fishes, esteemed for the use of the table, belong to the genus *Salmo*.

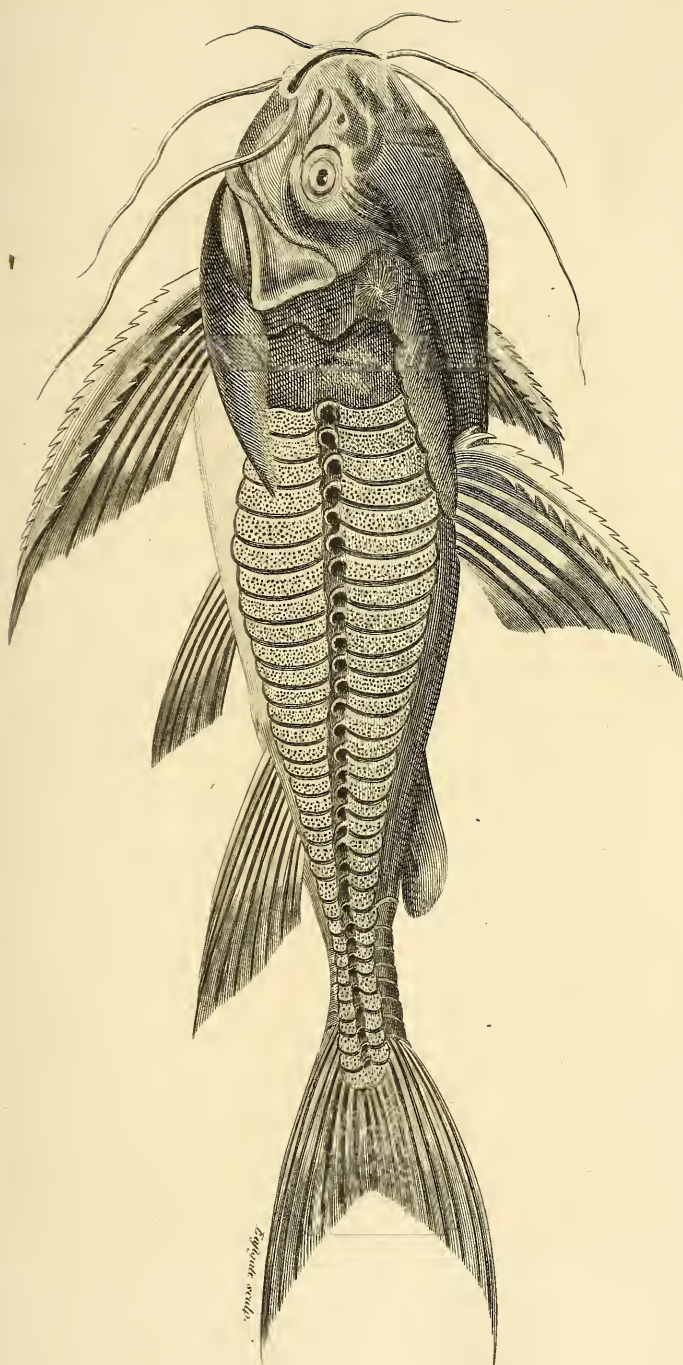
The genus *Esox* or Pike is known by its flattened head, wide mouth, sharp numerous teeth, and lengthened body, with the back and vent-fin

placed nearly opposite each other towards the end: the common Pike is a native of many parts of Europe, but is commonly said to have been first introduced into England in the reign of Henry the Eighth. In America are certain very large species of this genus, covered with very strong, bony, square scales, as if in a kind of armour.

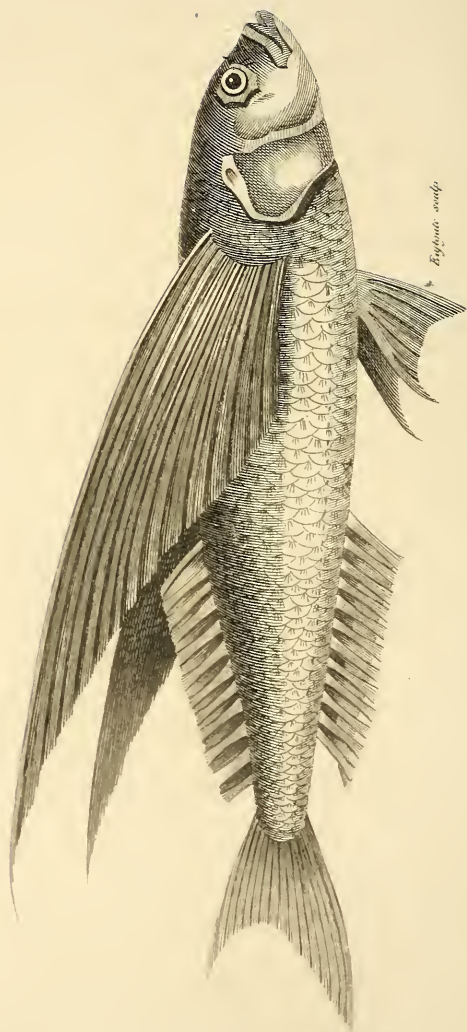
But the genus *Silurus* is a more remarkable instance of this bony kind of armature investing some particular Fishes. In the genus *Silurus* we have examples of Fishes entirely coated as if in a regular suit of armour. Many naturalists, however, choose to separate these armed species from the rest under different titles.

The curious genus *Exocoetus* contains the true or proper flying-fishes, or such as are particularly known by that name: this genus is by no means numerous; containing only four or five species. All are distinguished by a lengthened herring-shaped body, and pectoral fins of a vast length and size, and of a sharpened form. The common Flying-Fish is about the size of a Herring and of a silvery colour, with pale brown fins. It is often observed in the Mediterranean, sometimes singly, and sometimes in shoals, occasionally springing

RIBBED SLURTS

*English style.*

OCEANIC FLYING FISH



Exocoetidae

out of the water in order to avoid the rapacity of the larger fishes, and springing with expanded fins to the distance of about an hundred yards, and at the height of about three feet above the surface of the water, after which it is again obliged to plunge; its fins growing dry, and unable to support it any farther. The other species are chiefly natives of the Indian seas.

The Carp-Tribe, forming the genus *Cyprinus*, has for its character, a small mouth without teeth, which are placed at the entrance into the stomach; an oval oblong body, and, in general, a single back-fin. As an example of this genus I shall only mention the beautiful species called the Gold-Fish, which, as every one knows, is originally a native of China, from whence it has been gradually introduced into many parts of Europe; into England (if I mistake not) about the year 1691, but did not become common till about the year 1728, when a great many were brought over by Sir Matthew Decker, and by his means dispersed throughout the kingdom. Like the rest of the Carp tribe they are very long-lived, and are said to last above a century. As to the

common Carp it is supposed to arrive at the age of two hundred years.

We have now passed through all the *Linnean* orders of Fishes, but there still remains a large tribe which I before mentioned under the title of Cartilaginous Fishes. I also observed that they differ from all other fishes in having a comparatively soft or cartilaginous skeleton, and that some particularities in the structure of their gills induced Linnaeus improperly to rank them as an order of the Amphibia under the name of *Nantes*.

Of the Cartilaginous Fishes the first genus is that of *Petromyzon* or Lamprey. The character is a long, round, Eel-shaped body; a mouth furnished with numerous teeth in circular rows, and seven round spiracles or breathing-holes on each side the neck: these breathing-holes each lead into a tubular cavity, lined with a red pleated membrane, thus forming a series of organs analogous to gills in fishes, but not quite of a similar structure, and more approaching to that of lungs. The common or great Lamprey is an inhabitant of the sea, but comes into rivers during the spring. It is viviparous like the Eel, which it resembles in

its general habits. It sometimes is seen to swim with a considerable degree of swiftness, but is more commonly found adhering by the mouth to some large stone or other substance, to which it clings so powerfully as to require a great degree of force to separate it. As an article of food the Lamprey has long been celebrated. Its usual colour is a dull yellowish-white, clouded with brown or olive-coloured variegations. All the rest of the genus are of much smaller size, but in shape and way of living resemble the great Lamprey, except that they are confined to rivers.

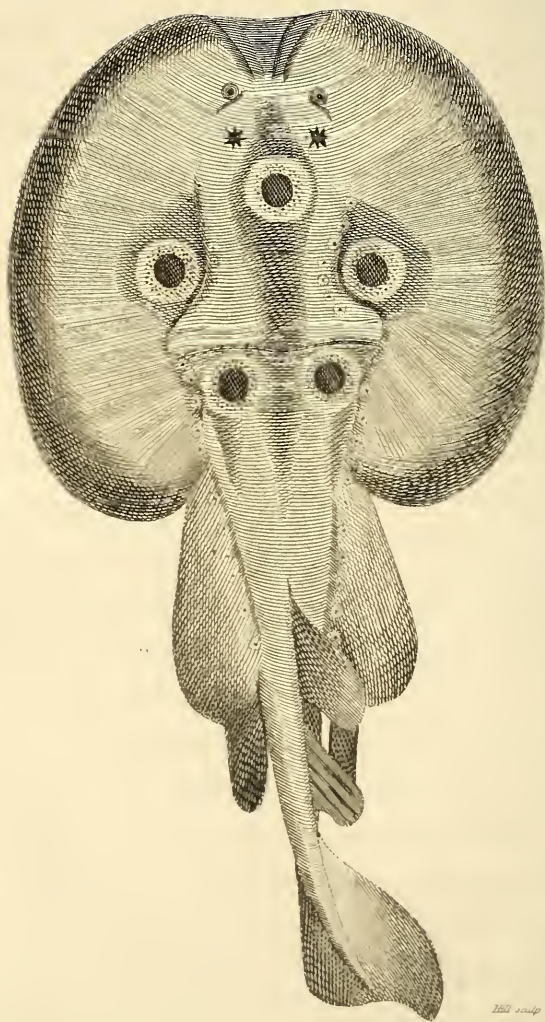
The next genus of the Cartilaginous Fishes consists of the Ray or Skate tribe, and is characterized by a flattish body, in some of a lozenge-shape, in others rounded, and in all furnished with a lengthened tail: the mouth is placed beneath the head, and is furnished with very numerous small teeth generally covering the lips or edges of the mouth; and on each side the neck beneath, are placed five large transverse slits or openings leading to the gills. The common Skate furnishes a good example of this genus, and is the *Raja Batis* of Linnæus. It often grows to a vast size,

sometimes weighing at least two hundred pounds: its general colour on the upper side is pale brown, with deeper variegations, and white, tinged with flesh-colour beneath. It is found in great plenty about the European coasts. Like the rest of the genus the Skate may be termed oviviviparous, discharging its young, each in a kind of oblong square capsule or pouch.

Some species of Ray are furnished with a very long and slender tail, towards the middle of which is attached a long, sharp, serrated spine, which the animal uses both as an offensive and defensive weapon: the wounds it inflicts with this spine are considered as highly dangerous, but the effect is produced by the mere puncture and laceration of the instrument, and not by any poisonous fluid, of which, as we have before had occasion to observe, all the fish tribe is destitute.

Among the most remarkable fishes of this genus, are those which are distinguished by a sort of forked or two-lobed head, with the side or pectoral fins extending to a great distance on each side. These kinds of Rays grow to a vast size, and are chiefly found in the Indian and American





TORPEDO RAY.

seas. We have accounts of an animal of this kind taken on the coast of Barbadoes, which required seven yoke of oxen to draw it along.

But the most curious species of Ray is the Torpedo, which is the *Raja Torpedo* of Linnæus, an inhabitant of the European seas, and sometimes taken on our own coasts, though much more common about those of France and Italy. The body of the Torpedo is of a rounded shape, and of a dull reddish-brown colour, with four or five large round dusky spots, and of a pale or white colour beneath; the tail is of moderate length, and terminated by a slightly rounded fin. The Torpedo possesses a similar electric or galvanic power with the *Gymnotus* before described, and has been celebrated both by ancients and moderns for its wonderful faculty of causing a sudden numbness or painful sensation in the limbs of those who handle it. The particular organs forming its electric or galvanic battery have been accurately described by Mr. Hunter in the *Philosophical Transactions*, and as the general history of the animal is now so well known, I shall at present content myself with saying, that the Torpedo from the first moment of its birth begins to exer-

cise its electric powers; and Spallanzani even assures us that having opened a Torpedo and taken out one of the young, he found that it communicated a very perceptible electric shock.

The next remarkable genus among the Cartilaginous Fishes is that of *Squalus* or Shark: In these animals the body is of a lengthened form; the mouth placed beneath, and furnished with numerous teeth, and on each side the neck are a certain number of transverse slits, leading to the gills, as in the Ray tribe: the number of these slits or openings differs in the different species from five to seven; but the prevailing number is five. It would be unnecessary to add that Sharks are animals of great rapacity, and that the larger kinds are among the most formidable enemies of the deep. The white Shark in particular, or *Squalus Carcharias*, has long been celebrated for its destructive powers, and is the dread of navigators in the warmer regions. It arrives at the length of more than thirty feet, and is of a pale grey colour: the mouth is extremely wide, and is furnished with from three to six rows of strong, flat, triangular, sharp-pointed teeth, serrated on their edges, and so placed in the cartilaginous

edge of the jaws as to be either raised or depressed at pleasure. So voracious is this animal that like many other inhabitants of the sea, it does not spare even its own species. An author of credit* relates that a Laplander had taken a shark, and fastened it to his canoe; but soon missed it, without being able to guess how: in a short time afterwards he caught a second, of much larger size, in which, when opened, he found that which he had lost.

The Sharks form a very numerous race, and some are distinguished by the elegance of their colours, as the Zebra Shark, an Indian species, of a brown colour, with white bars and stripes, and the blue European Shark, which is of an elegant bright blueish grey colour. Of those which have the most singular appearance the *S. Zygæna* or Hammer-headed Shark affords a curious example. It is of a brown colour, and grows to the length of fifteen feet: the head is lengthened out to a vast distance on each side, and the eyes placed at each extremity. It is an inhabitant of the Mediterranean sea.

The Sharks, like the Rays, are ovi-viviparous

* Leems.

fishes, and produce their young enclosed in oblong cartilaginous square sheaths, each corner of which runs out into the form of a lengthened and convoluted tendril.

The *Sturgeons* which I shall next mention, form a genus called *Accipenser*, and have a long body, covered above with rows of large bony tubercles; a lengthened, obtuse snout, furnished with four tendrils or beards; and a mouth placed entirely beneath, perfectly destitute of teeth, and only capable of closing by means of a strong cartilaginous edge or border. The Common Sturgeon grows to the length of eighteen or twenty feet, and is of a pale olive-brown above and white beneath. It is a sea fish, but frequents the mouths of large rivers during the early part of summer in order to deposit its spawn. It has been often celebrated as an excellent fish for the table, and was held in high esteem among the ancient Romans. From the roe or spawn properly pressed and salted is prepared the substance called Caviare. The fish called the Isinglass Sturgeon is of still larger size than the common one, and is the *A. Huso* of Linnæus: it is of a dusky blue colour above, and white or reddish white be-

neath, and is much less strikingly tuberculated than the Common Sturgeon; being sometimes found nearly smooth. It is from the sound or air-bladder of this species of Sturgeon that the substance called Isinglass is prepared.

The smallest species of Sturgeon yet known is called the *Sterlet*, which seldom exceeds the length of three feet. It is found in the Caspian sea, and in some of the Russian rivers, and is highly celebrated for the delicacy of its flesh. It is recorded of Prince Potemkin of Russia, that in seasons when the *Sterlet* was unusually scarce he has been known to give the sum of three hundred rubles for a tureen of *Sterlet* soup. The Caviar prepared from the roe of the *Sterlet* is a dainty still more expensive, and is said to be almost exclusively confined to the use of Russian Royalty.

I shall finish with a very hasty survey of two or three other remarkable genera of the Cartilaginous tribe. Among these the genus *Lophius* claims a place. It has a depressed head, numerous, sharp teeth, and pectoral fins furnished with a kind of joint resembling an elbow. The only European species is the *L. Piscatorius*, or

Angler, sometimes called the Toadfish. It is found about our own coasts, and grows to the length of six or seven feet. Its appearance is extremely singular, the head being of enormous size, and the mouth excessively wide. Its colour dusky brown above, and pale beneath.

In the American seas are found some species of a still more singular appearance, as the *L. Histrio* in particular, which exhibits one of the most grotesque shapes that can easily be imagined. It grows to more than a foot in length.

The genus called *Ostracion* or Trunk-Fish, has the body cased in a bony sheath or box, curiously divided or marked into angular spaces, leaving only the tail free or disengaged. The species of this genus are sometimes difficultly ascertained, on account of a certain similarity of structure: many of the most remarkable kinds have been admirably figured in the celebrated work of Dr. Bloch.

The genus *Diodon* is so named from the peculiar appearance of the mouth, the bony jaws of which constitute as it were two large teeth. Nothing can be more singular than the appearance of some of the leading species of this genus.

One of these is the *Diodon Hystrix*, or Porcupine-Fish, which grows to the length of about a foot and half, and is covered over with a strong skin, beset with very long and sharp-pointed spines, so that in point of habit or external appearance it may be said to connect in some degree the class of fishes with that of the spiny quadrupeds, such as the Porcupines and Hedgehogs. Another species has shorter spines with a much broader base.

There is a very remarkable European fish, sometimes referred to this genus, but which in reality should form a distinct one, commonly called the Sun-Fish or *Diodon Mola*. It is of a silvery colour with a cast of blueish brown; grows to a very large size, and perfectly represents the head of some large fish abruptly cut off from the body.

I must not omit observing that the genus *Diodon* is that which misled Linnæus into the idea that the Cartilaginous fishes were furnished with a kind of lungs as well as with gills. In order to ascertain this point he requested Dr. Garden of Carolina to examine into the organs of the Porcupine and other *Diodons* in a living

state: the result of these inquiries seemed to prove a species of real internal lungs; but the more accurate researches of others have since proved that these supposed lungs were no other than a particular kind of vesicular processes which the animal has the power of occasionally inflating in order to render itself specifically lighter and to ascend at pleasure with the greater facility.

W
 and various class of insects known by the title of insects. The characters by which insects are distinguished from other animals are the following. First, they are furnished with several feet. Next, few of them are furnished with a great trunk. Secondly, their heads are considerably part of the trunk, as opposed to the ordinary nature of the trunk, which is generally of a conical form. Thirdly, they breathe out of the ground, and are strong swimmers, and are more or less fond of water. The peculiarity in the organization of insects is by being furnished with a sort of internal lungs, which are situated at various points of the body, and which are capable of being inflated and deflated at pleasure.

LECTURE IX.

WE are now to direct our attention to a large and various class of beings known by the title of Insects. The characters by which Insects are distinguished from other animals are the following. First, they are furnished with several feet ; never fewer than six, and sometimes with a great many. Secondly their flesh, or the muscular part of their frame, is affixed to the internal surface of their skin, which is generally of a somewhat tough or strong substance, and in many even hard or horny. Thirdly, they breathe, not in the usual manner of the generality of the larger animals, by lungs, or by gills, but by a sort of spiracles or breathing-holes, situated at certain distances along each side of the body ; and lastly, the head is generally fur-

nished with a peculiar pair of processes called *Antennæ* or jointed horns, which are extremely various in the different tribes, and form a leading character in the institution of the genera or smaller assortments into which Insects are distributed.

The ancients seem to have entertained very vague ideas relative to the production of Insects, which they did not suppose to be conducted in the same regular and invariable order as in the larger animals, but to be owing to the putrefaction of various animal and vegetable substances; nor was it till towards the commencement of even the eighteenth century that the general history of Insects began to be clearly comprehended. Their forms and differences had indeed long before been studied with some degree of attention; but the accurate knowledge of their respective tribes, and their various states or transformations, had been but obscurely traced or understood.

The first state in which the generality of Insects appear is that of an egg. From this is hatched the animal in its second state, in which it is often called the Caterpillar, though this term more particularly relates to the insects of the Moth and Butterfly tribe. The Insect in this

its imperfect state has been called by Linnæus by the name of *Larva*, being as it were the mask or disguise of the animal in its future form. It is much to be wished that the word, with proper variation, might be received into our own language, under the name of *Larve*, by which means we should avoid the inconvenient term of Caterpillar, which is apt to convey the idea of one particular tribe of insects only. The *Larve* then differs very much in its appearance, according to the different tribe to which it belongs. In the Moth and Butterfly tribe, as before observed, it is emphatically called by the name of Caterpillar, and is universally known. In the Beetle tribe it is of a thick heavy form, with the body of a rounded and bulging appearance at the hind-part. In the Locust or Grasshopper tribe, and some others of the same order, it does not much differ from the complete insect, except in not being furnished with wings. In the Fly and Bee tribe and some others it is popularly known by the name of Maggot, and is of an oval-oblong form, without any feet. In the Dragon-Flies, and in the Water-Beetles, and some other insects, it is often of a very singular form, and differs more from the complete insect

than in any others except those of the Moth and Butterfly tribe.

When the time arrives in which the Larvè is to change into its next state, that of *Chrysalis*, or, as Linnæus calls it, *Pupa*, it ceases to feed, and having placed itself in some quiet situation for the purpose, lies still for several hours; and then, by a kind of laborious effort, frequently repeated, divests itself of its external skin, or larvè-coat, and immediately appears in the very different form of a chrysalis or pupa. The Chrysalis or Pupa differs in the different tribes of Insects almost as much as the Larvè. In most of the Beetle-tribe it is furnished with short legs, capable of some degree of motion, though very rarely exerted. In the Butterfly tribe it is perfectly destitute of all appearance of limbs, and has no other motion than a mere lateral bending or writhing when touched. In the Locust tribe it differs but very little from the perfect insect, except in not having the wings complete. In most of the Fly tribe it is perfectly oval, without any apparent motion, or distinction of parts. In the Bees and other Insects of a similar cast, it is less shapeless than in that of Flies, exhibiting the faint or imperfect appearance of the

limbs. In the Libellulæ or Dragon-Flies it is locomotive, as in the Locust tribe, but differs most widely from the appearance of the complete insect, and may be numbered among the most singular of the whole. I should here observe that the Linnæan term *Pupa*, which most modern entomologists substitute for that of chrysalis, was given from the indistinct resemblance which many insects bear in this state to a doll, or a child when swathed up according to the old fashion.

From the Pupa or Chrysalis emerges at length the complete insect, in its perfect or ultimate form, from which it can never after change, nor can it receive any further increase of growth. This last or perfect state of an insect is in the Linnæan language the *Imago*.

This surprising alteration of shape during the different periods of an Insect's life is to be considered as an evolution, or successive display of parts before concealed, and which lay masked under a different shape. Swammerdam persuaded himself that he could demonstrate all the parts of the future Butterfly, even in the body of the Caterpillar itself; and though this has been sometimes called in question, yet it may be easily con-

ceived that by a very accurate and delicate investigation, the rudiments of the future Fly may be detected in the Caterpillar, provided it be examined but a very few hours before its transformation into the chrysalis.

It is in the larve or caterpillar state that most insects are peculiarly voracious, as in many of the common caterpillars of Moths and Butterflies. In their complete state many insects are satisfied with the lightest and most delicate nutriment; some do not feed at all, while others, as several Beetles, Dragon-Flies, &c. devour animal and vegetable substances with a considerable degree of avidity.

Some insects undergo no change of shape, but are hatched from the egg complete in all their parts, and only cast their skin from time to time during their growth, till at length they acquire the full size of their respective species.

We must now attend to a few particulars relative to the general anatomy of insects. The major part of insects have the head distinctly divided or separated from the breast, and the latter from the body; thus forming three portions. The limbs in insects, as I before observed, are never

less than six in number, and in some insects much more numerous. They are, in general, divided or marked into a regular thigh, leg, and foot, which latter generally consists of several joints, and is in most insects terminated by a pair of curved claws.

The *Mouth* in some tribes of insects is formed for gnawing or breaking the food, and operates by a pair of strong, horny jaws, moving laterally, as in the Beetle tribe; while in others it is formed for suction, and consists of a tubular organ, furnished with proper accompaniments for facilitating its operation. In the Butterfly and Moth tribe it consists of a double tube, of different length in the different species, and when at rest, is rolled into a spiral form, and extended at full length when in use.

The *Stomach* varies in the different tribes of insects, and the intestines are generally rather strait, or usually make but few turns or bendings.

The existence of the *Brain* in insects is denied by Linnæus, but by this he can only be supposed to mean that it does not bear much resemblance to that of larger animals. In reality it is, as may be imagined, very small, and from it extends along

For down the back a kind of pulpy cord, analogous to the spinal marrow, and which ramifies into branches or divisions, which are conducted to the different parts of the body, and form the nervous system in insects.

The *Eyes* in insects differ in the different tribes, but by far the greater part of insects are furnished with eyes apparently two in number, and situated on each side the head. The outward surface, or coat of these eyes is composed of a prodigious number of minute hexagonal convexities, like so many convex lenses or glasses, but the exact manner in which vision is performed by these organs is not perhaps exactly ascertained. Some have supposed each of the hexagonal divisions or lenses to operate as a real and separate eye, and that the optic nerves are expanded into a separate retina or coat at the bottom of each. The head of a common Dragon-Fly or Libellula is furnished with no less than twenty-five thousand of these diminutive lenses. That they are really convex externally is certain, but that they are also convex on the internal or opposite part, though affirmed by many, may be doubted; and it is perhaps more probable that each is in reality what opticians

call a magnifying meniscus, having the outward or convex part of a smaller sphere than the concave or interior.

In Spiders the eyes are from six to eight in number; of a simple structure, and placed at a considerable distance from each other.

But besides the eyes just described, or those placed on each side the head, there are on the heads of many insects two or three small separate eyes, of a simple structure, and seated on the top of the head. They have been called by Linnæus by the title of Stemmata, and their real nature is not clearly understood.

The *Muscles*, or organs constituting the several portions of the flesh in insects, are far more numerous than in the larger animals, and are extremely sensible or irritable. In the human body it is observed, that the muscles can hardly be said to exceed the number of five hundred; but in a large Caterpillar, the anatomy of which has been given with laborious accuracy by Lyonett, the number of the muscles amounts to more than four thousand.

The comparative powers of the muscles in insects are also far stronger than in the larger ani-

mals: thus we know that a Flea and a Grasshopper are capable of springing to a much greater distance in proportion to the length of their bodies than any quadrupeds; for a Flea is capable of springing at least 200 times its own length; whereas the Jerboa and the Kangaroo, in their most powerful springs fall very far short of the same proportional distance.

We have before observed that insects are not provided with lungs, like the higher orders of animals, but that they breathe by means of a certain number of pores or small openings, generally placed on each side the body, and which are continued into very numerous branches, dispersed about the body of the animal. If the lateral pores or breathing-holes in insects be stopped, by rubbing them with oil or any other substance capable of excluding the air, the animal, after a certain time, falls into convulsions and dies.

It has been a matter of doubt among naturalists, and particularly those of the French school, whether insects can properly be said to have a circulation of the blood; and whether they have any organ that can properly be called a heart.

The celebrated Cuvier seems to suppose that they have not. It is acknowledged indeed that the animals of the Crab and Lobster tribe, the Monoculi, and others of that particular cast, have a genuine circulation; but these animals should, according to some Zoologists, be separated from insects, and form a distinct division in the animal kingdom. Nay Monsieur Lamarck is willing to exclude even the Spider tribe from the class of insects, because in these animals the heart and circulation of the blood are distinctly visible.

The organ which the famous Italian anatomist Malpighi supposed to constitute the heart, or rather a kind of chain of hearts, in the Silkworm, has been since proved to be a vessel of a different nature, the use of which does not appear to be fully understood; but no ramifications of blood-vessels proceed from it.

It seems to have escaped the attention of those who are not willing to allow a circulation of the blood in insects, that, though it may not be perceptible in the major part, yet it certainly appears to take place in some which are allowed on all hands to be genuine insects; and particularly in the genus *Cimex* or Bug. I shall here give a quotation on

this subject from an author, who, though he cannot be supposed to have deeply investigated the anatomy of insects, was yet an excellent general observer, and who detailed with great plainness and accuracy his own observations, viz. Mr. Henry Baker, the celebrated microscopic observer. In speaking of the common Bug or *Cimex lectularius*, Mr. Baker says: “In the legs of these insects, when very small, the current of the blood is remarkably visible, together with an extraordinary vibration of the vessels, which I have never observed in any other creature; and though one of these animals has been confined between two glasses for many weeks together, so as not to be incapable of stirring, and has at times appeared dead, yet a little warmth, properly applied, would renew the motion of the bowels, and the circulation of the blood as briskly as ever.” Mr. Baker also observes that the circulation of the blood may be perceived in the wings of Grasshoppers, and that the globules of the blood in those animals are of a green colour.

After this general description of the nature of insects at large, I shall proceed to a slight survey of the several families or divisions into which they

are systematically distributed for the convenience of investigation and arrangement; and shall give a few examples of each division.

The Linnæan system of entomology being of all others the most elegant and easy, will be best calculated for our purpose. Linnæus distributes all insects into seven *Orders* or great assortments, the first of which contains all the insects of the Beetle tribe, or such as have strong horny sheaths or covers to their wings. I must here observe, that the term Beetle is more particularly restricted to one single genus so called, but in a general sense it takes in the whole tribe called by Linnæus *Coleoptera* or sheath-winged insects. In these animals the real or proper wings are of a membranaceous nature, and when not in use are curiously folded under the exterior strong or horny sheaths. The Coleopterous insects form a very large or extensive order; the genera or particular sets being very numerous, and each distinguished by some leading particularity of appearance.

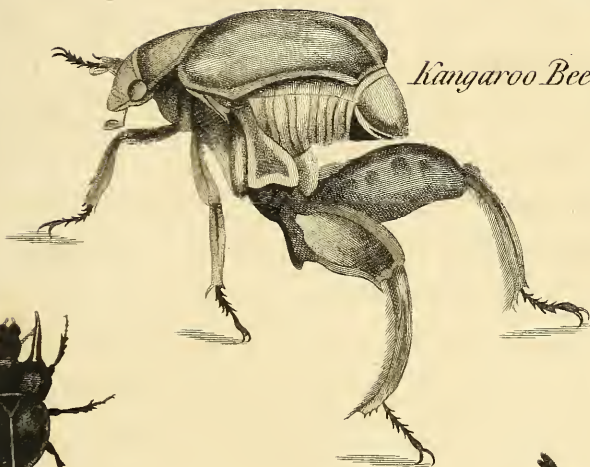
In the genus Beetle, properly and emphatically so called (in Latin *Scarabæus*,) the distinctive character is that the antennæ or horns are furnished at the tip with a slightly-expanded part, divided

into several distinct plates or laminæ, as in the common Cockchaffer, which being one of the most frequent insects in this country, must be supposed to be known to almost every one. It proceeds from a yellowish-white larve, of a disagreeable appearance, which resides under ground, and feeds on the roots of corn and other grasses, and is supposed to continue at least three years in that state before it gives birth to the complete insect. Among the exotic Scarabæi or Beetles many are found of a gigantic size in comparison with those species which are natives of Europe; some measuring four, five, or even six inches in total length. The genus is also extremely extensive, and so singular is the appearance of many, that hardly any variety of horn or process can be conceived, which is not found exemplified in some particular species. As a proof of this we may take a view of some of the exotic Beetles represented in the works of Monsieur Olivier, Mr. Drury and others. I shall also particularize one insect of this genus, which, I believe, exists only in the splendid collection of Mr. Francillon, and which, from its very peculiar appearance, has been named the Kangaroo Beetle.



Cockchafer

Larva of Cockchafer



Kangaroo Beetle



Momus

Mobilicornis



Griffith sculp

ENEMA

Among the most numerous genera of the Coleopterous or sheath-winged insects is that of *Cerambyx* or Goat-Chaffer, which contains a vast variety of species; some of extraordinary size, and of beautiful colours*. One of the principal English species is the *Cerambyx moschatus* or Musk Goat-Chaffer, a beautiful insect of more than an inch in length, and with very long, jointed horns. It is of a fine dark golden-green colour, and diffuses to a great distance a very fragrant scent, like that of a mixture of musk and roses. It chiefly appears in the hottest part of July, and is seen on willows and poplars in particular.

A genus still more numerous than that of *Cerambyx* is called *Curculio* or Weevil, and is easily distinguished by the remarkable situation of the antennæ or horns, which are placed on the snout itself, which in this genus is often of a considerable length. In this genus stands the famous insect generally known by the title of the Diamond-

* This genus has a rather lengthened body, and very long antennæ in most species.

Beetle, a native of Brazil, and remarkable for the extreme brilliancy of its appearance, which is owing to numerous rows of scaly spots of a golden green cast, disposed on a jet-black ground, and accompanied by a variable or iridescent lustre. The magnified figure (here represented) will give a clearer idea of its appearance than any verbal description. It is an insect which varies considerably in size, but is usually something more than an inch in length.

To the genus *Curculio* also belongs the curious animal the Nut Weevil, a small brown insect, with an extremely long and slender snout. This insect is the parent of the maggot in the hazelnut, which is known to every body. About the beginning of August, the female *Curculio* wanders about the hazel-trees, while the nuts are in a very tender state, the rind of which she perforates with her snout, and deposits an egg in the puncture; and thus continues to do, till she has deposited her whole stock. The nut, not apparently injured by this slight perforation, continues to grow, and gradually ripens its kernel. When the egg is hatched, the maggot, finding its food ready-prepared, begins to feast on the kernel.

By the time it is fully grown the natural fall of the nut takes place, and the animal, not at all injured by the shock, creeps out at the circular hole which it has previously prepared, and immediately burrows under ground, where, after a certain time, it casts its skin and commences chrysalis, or pupa, in which state it remains all winter, and till the beginning of the following August, when it emerges from its concealment and appears in its complete form. Its colour is a dull, uniform brown.

The order Coleoptera or the sheath-winged tribe contains a great many other very curious genera, both of large and small size, but the limits of our Lecture will not allow us to particularize more than a few examples of each order of insects.

I shall therefore now pass to the second Linnaean order, called *Hemiptera*, or as it were Half-winged insects; for in this order the wing-sheaths are of a tough or leathery constitution at their upper part, and soft, or membranaceous at the lower, and the real or under-wings are often of great size, and pleated longitudinally in the manner of a fan. This order contains all the in-

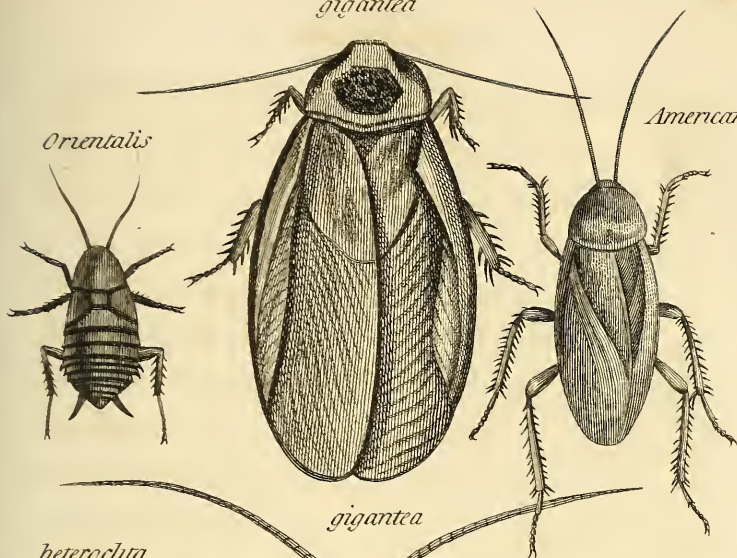
sects of the Locust and Grasshopper tribe; the Cockroaches; the Lantern-Flies; the Cicadæ, and many others, some of large and some of very small size.

The genus called *Blatta* or Cockroach is distinguished by the flattened form of the body; by a pair of long, bristle-shaped horns at the head, by the wings lying horizontally over the body, and by a pair of tips or processes resembling short horns at the end of the body. The Cockroaches are a numerous and disagreeable tribe; generally running very swiftly, chiefly appearing by night, and feeding on almost all kind of animal substances: they are mostly natives of warm climates: the species now so very common in this country, and especially in the metropolis, is supposed to have been originally imported from the Eastern regions; it has obtained among the London vulgar the very improper title of the *Black Beetle*, a name which not only confounds it with a species of real Beetle, emphatically so called in the country, but also leads people erroneously to suppose it of the Beetle tribe or order *Coleoptera*. It is the *Blatta Orientalis* of Linnæus, and should be called the Eastern or Oriental Cockroach. To

gigantea

Americana

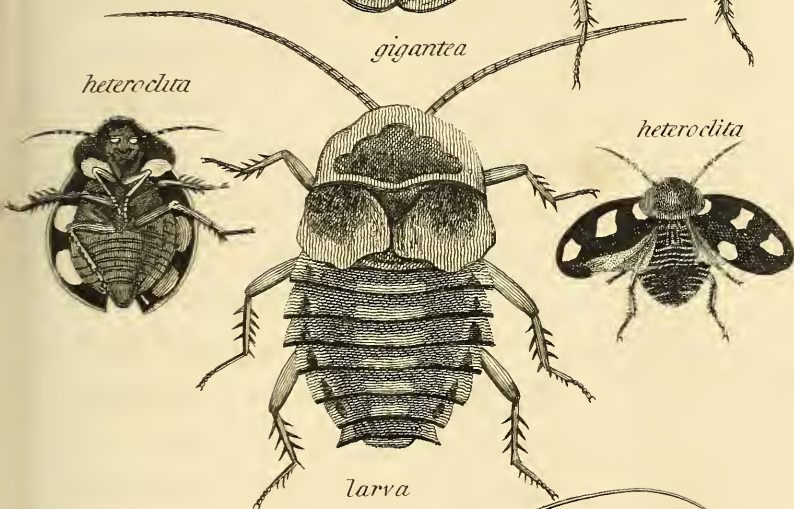
Orientalis



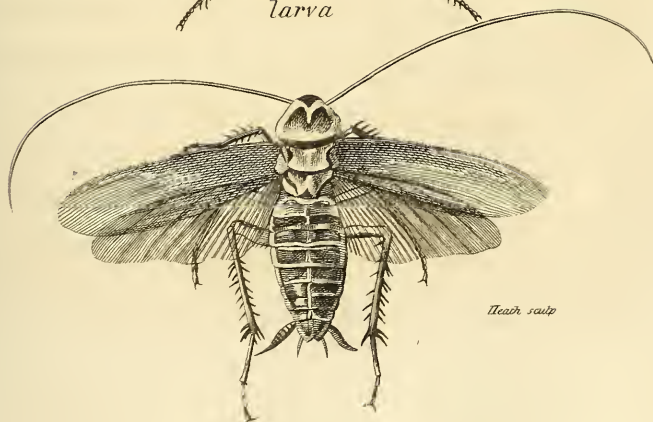
heteroclita

gigantea

heteroclita



larva



Heath sculp

Americana

be particular in its description would be unnecessary. In South America and the West Indies is a species much resembling it, but of a rather larger size, of a longer shape, and of a fine chesnut-colour: it is the *B. Americana* of Linnæus or American Cockroach, and is excellently figured by the celebrated Madam Merian, in her splendid work on the insects of Surinam. But the most remarkable and destructive of all the Cockroaches is the *B. gigantea*, or Great Cockroach, found in many parts of the West Indies and America. It is often seen of nearly the diameter of an egg, and is of a brown colour. Like the rest of the tribe, it comes out chiefly by night, and devours almost every article of an animal nature, thus committing great devastation in domestic articles. It has also a most troublesome practice of making a kind of drumming noise behind wainscot or paper by night, so that only those who are very good sleepers can repose in rooms which are haunted by this insect. It is figured in the elegant work of the late Mr. Drury.

But the ravages committed by the *Blattæ* or Cockroaches are chiefly of a domestic nature, and fall infinitely short of those inflicted on mankind

by the *Locust tribe*. The genus *Gryllus*, comprehending all the kinds of Locusts and Grasshoppers, is wonderfully numerous, and is distinguished by a large head, with strong jaws; slender horns, a lengthened body; and the hind-legs formed for leaping. Among the species most remarkable for their ravages is the *Gryllus migratorius* or migratory Locust, which of all the insects capable of injuring mankind, seems to possess the most dreadful powers of destruction. Legions of these animals are from time to time observed in various parts of the world, but more particularly in the Eastern regions, where the havoc they sometimes commit is almost incredible. The sun is often darkened by their numbers while the swarm is in the act of migration; so that at mid-day people can hardly distinguish each other. They settle on the richest parts of the country, and in a few hours devour all the corn and other vegetables, and change the most fertile province into the appearance of a barren desert. In the year 1748, some straggling flights, which had committed considerable havoc in some parts of Germany and France, were observed to make their appearance in England, and were even seen about and in the

*G. cristatus*

1803, Oct 1 London Published by G. Hearsey, Print-Seller.

metropolis itself; but as they were evidently driven out of their course by adverse winds, and were much weakened during their flight, they soon perished. Straggling specimens are from time to time observed, but happily this insect can hardly be fairly numbered among the regular native insects of England. Its general size may be observed in the figures we are now viewing, which are copied from those of the admirable Roesel, an artist of such transcendent excellence in his mode of representing the smaller animals, that in the words of Mr. Fuseli he may be said to have raised insect-painting almost to the dignity of History.

A species of Locust of much larger size and of great beauty of colours is that called *G. cristatus* or the crested Locust, so named from the rising processes on the top of the back. This species is at least five or six times the size of the migratory or wandering Locust, and is a native of the Eastern regions. It is often salted, and used as an article of food in many parts of the Levant, and it is supposed that it was the food of saint John during his state of retirement in the desert. It has indeed been sometimes supposed that the

word *angidas* in the sacred writings, may rather mean the tender shoots of vegetables; but since the fact is so well ascertained that Locusts are still eaten in those regions, we need not admit any other interpretation than the common one; nor need we wonder that an abstemious Anchorite, during his state of solitary seclusion from the commerce of the world, should support himself on a food which certainly is not to be numbered among the luxuries of life, but merely to be regarded as a substitute for food of a more agreeable nature.

I shall only mention as a farther example of the Hemipterous insects, the beautiful genus *Fulgora* or Lantern-Fly. It is distinguished by the peculiar structure of the head, which in most species, and more especially in the great or chief kind, is of a large, lengthened, and inflated form, as if swelled out with air; and the mouth consists of a long, slender tube, lying beneath the breast. The *F. Lanternaria* or South-American Lantern Fly is certainly one of the most curious, and even one of the most beautiful of insects. It is a native of many parts of South-America, and is common in *Surinam*, where it was observed in par-



E. Lanternaria

Heath sculp

ticular by the celebrated Madam Merian, and is figured in her most elegant work on the Surinam insects, where she gives an entertaining account of the surprize into which she and her domestics were thrown on first observing these insects to shine by night, like so many flames of fire in the room into which they had been introduced. The insect is of the size represented in the figures we are now viewing. Its colours, when living, consist of a beautiful variegation of brown, green, and red, on a yellowish ground, and the under wings are decorated by a large eye-shaped spot on each. The light afforded by the fire or Lantern-Fly proceeds entirely from the head, and is said to be sufficient to enable a person to read the smallest print by; as well as to travel with by night in the manner of a torch, if tied to the end of a stick. Madam Merian was somewhat deceived as to the larva or first stage of this insect, which she confounds with a species of Cicada, and this is one of the most remarkable oversights in her work; in which, if there be here and there a few inaccuracies in her descriptions, we must at least allow that the general elegance of her figures can hardly be surpassed.

We now pass to the most splendid of all the orders of insects, entitled *Lepidoptera* or *scaly-winged insects*. It consists of all the Moth and Butterfly tribe, or the Papilionaceous insects, as they are often called. The powder or down on the wings of these insects has been often considered by naturalists as composed of a kind of feathers; but in reality it is composed of a kind of very minute scales, which differ in size and form in the different species, as well as on the different parts of the same species: their general appearance is that of an abrupt oval, terminating in several projecting points at the abrupt or broad end, and fastened by a small quill or point at the root or opposite end to the membrane of the wing. The Lepidopterous insects, or the Butterfly and Moth tribe are divided by Linnæus into three distinct genera or sets, under the titles of *Papilio*, *Sphinx*, and *Phalæna*, or Butterfly, Sphinx, and Moth. They all proceed from Caterpillars, which afterwards change into a chrysalis, out of which, after a certain period, emerges the complete insect.

This change is so familiarly known as to supersede the necessity of any particular description.

In the Butterflies, the wings, when the insect is at rest, are so placed as to meet upwards, or by their upper surfaces applied to each other; and the horns or antennæ in most species terminate in a small head or club. The genus *Papilio* or Butterfly is so astonishingly numerous, that in order to facilitate the investigation of the species, it is absolutely necessary to divide them into several sections instituted from the particular shape of their wings and other particulars. This has been done with great elegance by Linnæus. The largest of the genus, and such whose wings if measured from the inner or lower corner to the tip are longer than if measured from the same corner to the base or shoulder-part, are termed *Equites* or *Knights* or *Chiefs*, and are ingeniously divided into *Greeks* and *Trojans*, and named from the principal Heroes of the *Iliad*. The *Trojans* are distinguished by red or blood-coloured spots on each side or near the breast; and are generally of dark colours. The *Greeks* have no red marks near the breast, and are generally of more brilliant colours: but some inaccuracies have been observed in the Linnæan arrangement, which are easily rectified by slight transpositions. Of the

Trojan division one of the most magnificent is the *Papilio Priamus* or great black and green Amboina Butterfly ; and of the Greek division the European species called *Papilio Machaon* or Swallow-tailed Butterfly may serve as an example.

The remaining sections of the Butterfly tribe are distributed according to rules equally ingenious, and by which the student in Entomology is in general enabled to refer each to its proper division ; but I shall not at present particularize these, but shall proceed to the genus *Sphinx*. This genus is distinguished by the slightly angular or prismatic form of the antennæ or horns, which are generally short in proportion to the animal ; and by a peculiar thickness of the body, which in most terminates in a point. The name of *Sphinx* is applied to this genus from the favourite posture often assumed by the Caterpillars of many species ; which have a habit of slightly raising the fore-part of their body in such a manner as to bear some resemblance to the figure of the Egyptian Sphinx. In this genus are many insects of great beauty and elegance ; particularly among the exotic species. Most of their Caterpillars undergo their change into chrysalis at a considerable depth beneath the

*M. Griseb. sculp.**Priamus*



MACHAON
or
Swallow Tailed Butterfly



Sph. ocellata.

M. Gröthius sculp.

*Heath sculp.**Ph. Junonia.*

surface of the ground, into which they retire at the time of their approaching change; and after lying, in some species a few weeks, in others many months, the chrysalis, by the motions of the included animal, forces itself up to the surface, and gives birth to the Insect in its perfect form. The insects of this genus are often called Hawk-Moths by the English collectors.

The genus *Phalæna* or Moth is distinguished by sharp-pointed horns, which in many species are simple, and in many are beautifully barbed or feathered along the sides. This genus, like that of Butterfly, is so very numerous, that it is divided into many sections, instituted from the habit or general appearance of the animals, combined with some other circumstances. These I shall not particularize, but shall merely observe that of one or two of the leading species. Of all the European Moths by far the most magnificent is the *Phalæna Junonia*, a name which I have myself applied to it, in order the more effectually to separate it from some smaller species of similar appearance, with which Linnæus has conjoined it. It often measures six inches in breadth, when expanded, and is found in Germany, France, and Italy, where its

Caterpillar, which is very large and beautiful, feeds on the leaves of apple and pear-trees and some others. The complete insect exhibits a beautiful assemblage of different shades of grey, and each wing is marked in the middle by a most elegant and conspicuous eye-shaped spot.

The *Phalæna Cecropia* of Linnæus is a very fine insect, and is not uncommon in many parts of North-America. Its Caterpillar is of a green colour and a remarkable appearance, and has been elegantly represented in the beautiful work on the Insects of North-America by a Mr. Abbot, accompanied by excellent notes and illustrations by our celebrated botanist Dr. Smith of Norwich.

I shall proceed to give a general explanation of the remaining Linnæan Classes of Insects.

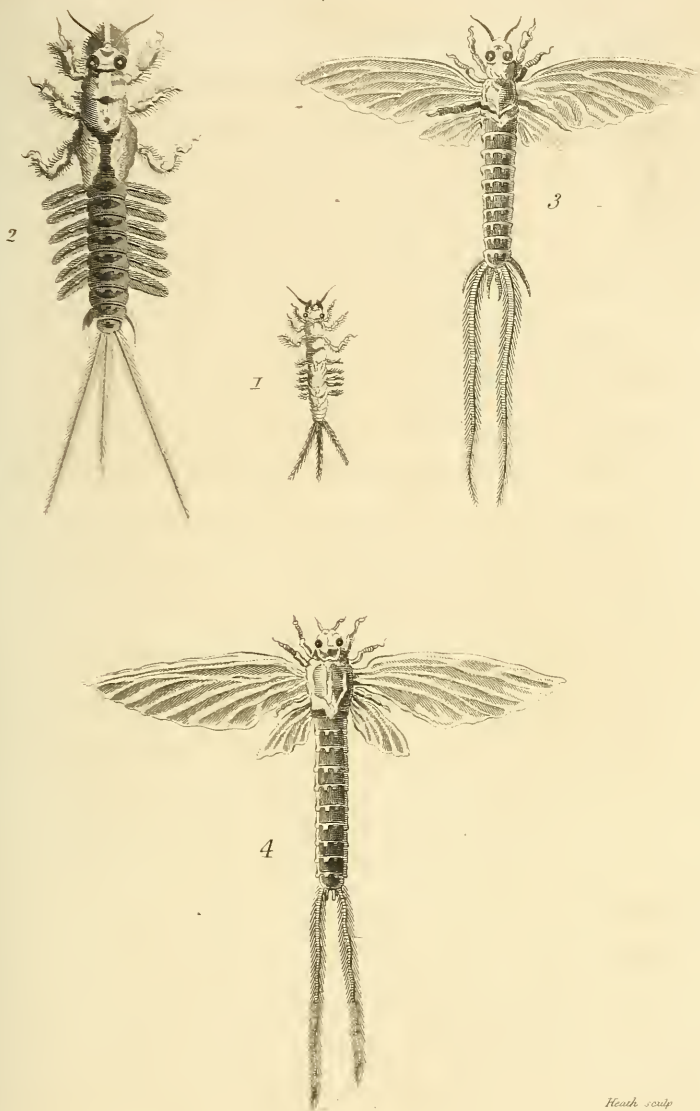
The Class *Neuroptera* or Nerve-Winged, or *Fibre-Winged* Insects consists of such as have four large wings, furnished with very conspicuous nerves, fibres, or ramifications dispersed over the whole wing. This order is exemplified in those elegant and very common Insects called Dragon-Flies, as well as in May-Flies, and many others. I shall content myself with giving as an illustration of this order the common *English*

Dragon-Fly, or Libellula varia. It is a large and beautiful Insect, seen chiefly towards the decline of summer, principally in the neighbourhood of watry places; it has a very large head, with conspicuous eyes, large transparent wings, with black veins, and a very long body, richly variegated with blue and black. It is of a very rapacious nature and preys on the smaller insects, but is perfectly destitute of any sting as vulgarly supposed, and is incapable of injuring any of the larger animals. It proceeds from a larve which inhabits the water, and is of a very peculiar and unpleasant form. During its larve state, which continues at least two years, it is as rapacious as when in its complete form, preying on the smaller kind of Water-Insects. When the period is arrived at which it is to give birth to the Dragon-Fly, it ascends the stem of some water plant, and by a few efforts, breaks open the skin of the back, when the enclosed Dragon-Fly gradually liberates itself from its confinement; its wings which are at first very short, tender, and contracted, gradually expanding themselves to their full size, like those of a Butterfly when newly emerged from its chrysalis. In the space

of about half an hour the change is complete, and the same animal which before that time would have been killed by any long exposure to the air, would now be as effectually destroyed by submersion under water.

The celebrated Insect called the Ephemera belongs to this Order, and proceeds likewise from an aquatic larve. The common May-Fly or Trout-Fly is a species of Ephemera, which emerges from its chrysalis chiefly in the month of May. But the most celebrated animal of the genus is that described by the famous Swammerdam and held up as the most curious instance of the brevity of animal life, since, when one arrived at its complete or perfect form, it lives only about six hours. It must be recollected however that the animal has lived three years in its former or larva state, so that its brevity of life is only to be referred to that of its complete or perfect form. The size of this remarkable animal, which is not a native of England, but is common in many parts of Europe, is given on the plate we are viewing. Its colour is white, with a yellowish body, and the larva is of a pale brown.

The Insects of this genus have one particu-

Swammerdamiana*Heath sculp*

- 1 larva in the first year's growth
- 2 larva full grown
- 3 male *Ephemera*
- 4 female *Ephemera*

larity in their history which is unexampled in that of any other. This consists in the double change of the winged insect, which as soon as it springs from the chrysalis, flies to some adjoining body, and then again divests itself of its skin, that of the wings themselves not excepted.

The Order *Hymenoptera* consists of Insects with four membranaceous wings, but not remarkably fibrous as in the former Order*. It contains all the Wasp and Bee tribe; the Ichneumons and a variety of others. The general history of the Bee and Wasp tribe being pretty familiar to most persons, I shall confine myself to an example or two from the genus *Ichneumon*, the habits of which, so far as relates to the production of their young, are peculiarly singular. The genus *Ichneumon* is distinguished by long, slender antennæ, with a great many joints, and by the very slender process which connects the breast with the body of the animal, and which in many species appears like a kind of footstalk.

* They are also furnished in general with a sting or piercer, which in some is innocent, while in others it is calculated for the discharge of a highly acrimonious or poisonous fluid, as in wasps and bees.

These insects deposit their eggs in the bodies of other living Insects, and generally in those of Caterpillars. For this purpose the female Ichneumon selects her victim, and in spite of all the efforts of the tormented animal, pierces its skin, and deposits her eggs beneath: the Caterpillar after the first pain is over appears to suffer nothing; but after a few days the inclosed eggs hatch, and the larvæ of the Ichneumons are nourished by the juices of the Caterpillar, which at length dies in consequence; but sometimes not till it has undergone its change into a chrysalis.

Some very minute Ichneumons deposit their eggs in even the eggs themselves of Moths and Butterflies. So small are some species of this very numerous genus.

The next Order, called *Diptera*, consists of Insects with two wings only, as the whole race of Flies, strictly so called, as well as Gnats and a great variety of other Insects.

All the real Flies, or those of the genus *Musca*, are derived from Maggots, which have themselves been hatched from the eggs deposited by the parent Flies. But of these Maggots many differ greatly from each other both in form as well as

in manner of life and place of residence, some living on putrid animal substances, some on the smaller insects; and some are of an aquatic nature. Some Flies, as a species greatly allied to the common Window-Fly for instance, are oviviparous, producing living Maggots, which have themselves been first hatched internally.

The Common Gnat belongs to a genus called *Culex*, and is sufficiently known to supersede the necessity of particular description. It deposits its eggs in groupes on the surface of stagnant waters, and the young during their larva state are of a very peculiar appearance. When changed into the chrysalis state they are still loco-motive, and when ready for the production of the perfect Insect spring to the surface of the water, and give birth to it.

In the genus called *Æstrus* or Gad-Fly the eggs are laid by the parent insect in the skin of the backs of Cattle, in one species; in others in the nostrils and other parts of Deer and Sheep: the larves, when arrived at their full size, creep out, and retiring beneath the surface of the grass or under any convenient body, change into a chrysalis, from which in a certain space springs the animal in its ultimate form.

The last Order of Insects is called *Aptera*, and comprises Wingless Insects. It consists, according to Linnæus, of the Crab and Lobster tribe, of Spiders, Scorpions, Centipedes, Monoculi, Mites, and many other Insects. But, as I have before observed, some of the French zoologists have been inclined to dismiss the Crab and Lobster tribe, the Monoculi, &c. from the class of Insects. The Crabs and Lobsters, as is well known, cast their skins annually, the body shrinking before the change, and enabling them easily to draw out their limbs from the shell: the animal being then in a weak and tender state, remains in some quiet retreat till its new shell is completely grown. This genus is excessively numerous, and some of the species are extremely small. The larger animals of the kind, as the larger kind of Crabs for instance, possess the extraordinary power of casting off at pleasure any limb that happens to be accidentally maimed or bruised, instead of waiting for a gradual convalescence: a new limb is soon afterwards formed, which gradually supplies the place of that which had been voluntarily cast off.

The *Scorpions*, forming the genus *Scorpio* of

*Americanus**Aër**Europæus*

Heath scorp



Linnaeus, are distinguished by their oblong body, eight legs; two large claspers or claws in front, and long, jointed tail, furnished at the tip with a crooked and very sharp-pointed sting, provided with a poisonous fluid, which is injected into the wound caused by the sting. The Common or Italian Scorpion measures about three inches from the head to the end of the tail, and is of a reddish-brown colour. It is very common in the warm parts of Europe, and though its sting causes painful symptoms yet it is rarely productive of any real danger. But the Great African Scorpion, with a body as large as a Crawfish, and measuring eight or nine inches from the head to the tip of the tail, is a far more dangerous animal, and its sting is said to be often fatal. It is found in the hotter regions of Africa.

I shall only mention one or two more genera of the Apterous or Wingless Insects. The genus *Aranea* or Spider has eight eyes, situated separate from each other on the top of the head. The mouth is armed with two strong fangs or holders, the tips of which are each furnished with a small hole or slit, through which is discharged a poisonous fluid, sufficient to destroy or kill the mi-

nute animals on which Spiders prey. The legs are eight in number, and at the end of the body are four or five small teats or organs through which the animal draws its thread. Each of these teats is pierced with a vast number of holes through each of which proceeds a distinct thread, and the animal can either draw its thread from all the holes at once or by any particular number; in short what we call a single spider's thread may consist, according to some computists, of not less than six thousand distinct filaments. The size to which the European spiders arrive is not very great, but the hotter regions of Africa and America produce spiders of a size so gigantic as to be formidable even to birds and many other animals on which they prey. One of the chief of these is the *Aranea Avicularia* or Bird-catching Spider, of which very capital specimens may be seen in the Leverian Museum. These Spiders are found principally in the hotter parts of South-America.

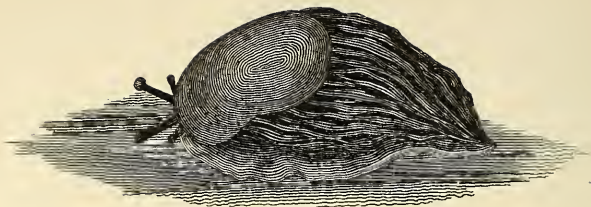
The genus called Acarus or Mite contains the smallest of all known Insects, as well as some of considerable size. The mites are a very numerous race. The generic character consists in having eight legs, and in many species a kind of claspers,

*A. aricularia**It grows souly.*

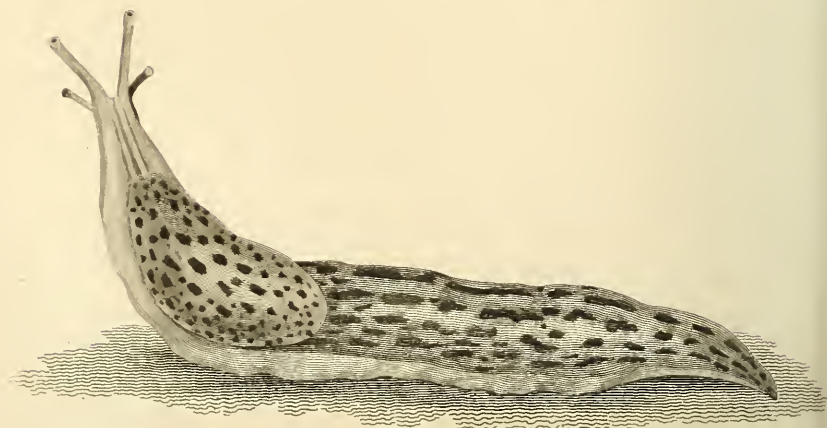
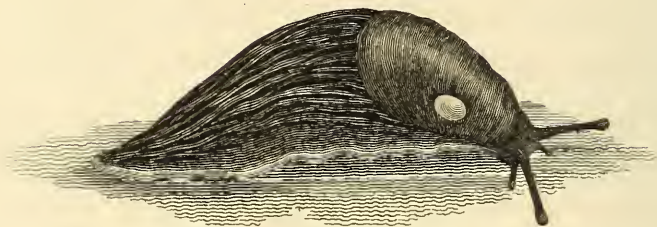
operating as a pair of additional legs. The body is of a thick and roundish shape; in some species nearly globular, and in others flattish. The common Cheese-Mite or *Acarus Siro* of Linnæus is a familiar example of the genus. It proceeds from an egg deposited by the parent insect, and is at its first hatching, perfectly like the parent except in size, and in wanting the third pair of legs, which do not make their appearance till after the first casting of its skin. The Mite is beset with long hairs, and if it be accurately surveyed by the microscope, it will be found that these hairs are not of a simple structure, but are bearded along the sides in the manner of the bristles on an ear of barley.

To the genus *Acarus* or Mite belongs a very curious Insect popularly known by the name of the Harvest Bug, which is of a bright scarlet colour, and so very small as to be but just visible to a good eye without the assistance of a glass. In the middle of summer, or rather towards its decline, this little animal is often peculiarly troublesome by attaching itself to the skin of those who walk among long grass or through corn fields.

It is even to a species of Mite that the cutaneous disorder so common among the vulgar of almost all nations has been supposed to owe its existence. At least it is certain that a particular disorder of that kind is really caused by a very small species of Mite, which insinuates itself beneath the cuticle and causes extreme irritation. This disorder, though not often noticed by modern physicians, appears to have been well known in this country about the time of Queen Elizabeth; and is very distinctly recorded by Mouffet in his History of Insects. The animal has hardly any where been figured with sufficient exactness except in the work of Baron Degeer. The figure we at present view is a very correct representation of the animal, which is of a white colour, with reddish brown head and hind-legs: it is chiefly distinguished as a species by having the two pair of fore-legs excessively thick at their origin, and terminating in a slender tube; while the four hind-legs proceed from a very narrow base, then suddenly enlarge into an oval shape, and from thence gradually stretch into a long and sharp-pointed bristle.



BLACK SLUG



L. maximus J. G. S.

LIMAX MAXIMUS
— or —
Spotted Brown Slug



LECTURE X.

THE *Mollusca* or soft-bodied animals, are, in the Linnæan arrangement, divided into such as are destitute of a shelly covering, and such as are furnished with one. In our present lecture we shall turn our attention to the first of these tribes, or Soft-bodied Animals without any truly shelly or very hard integument, though some of them, as we shall perceive when we arrive at such particular genera, have a kind of coriaceous, and even a crustaceous covering. In giving a view of the Linnæan *Mollusca*, it is not my intention to pass formally through every genus, but to select as examples such as are either most important or most curious.

The genus *Limax*, which stands first on the list, may be considered as important; since it forms, as it were, the type or pattern of most of

the Animals inhabiting the univalve, spiral shells, whose inhabitants are formed on the same plan. The genus *Limax* or Slug is characterized by having an oblong body, furnished above with a fleshy shield, and beneath with a flattened expansion, answering the purpose of a foot or locomotive organ. On the right side of the breast is a large orifice; and on the front of the head are four feelers or tentacula, or, as they are popularly termed, *horns*. The most familiar example of this genus is the common black Slug, generally called the black Snail, so frequently seen in fields and gardens in damp weather. There is also another species, rather larger and of a brown colour, found in similar situations; but the largest of the British species is the *Limax maximus* of Linnæus, which somewhat exceeds the size of both the former, and is of a pale greyish-brown colour, spotted and streaked with black. All these animals feed entirely on vegetables, and are produced from whitish gelatinous eggs, deposited in shady situations, beneath the surface of the ground. In almost all particulars, except in not being furnished with a shell, they resemble the common or Garden Snails.



DORIS PAPILLOSA



Unica sculp.

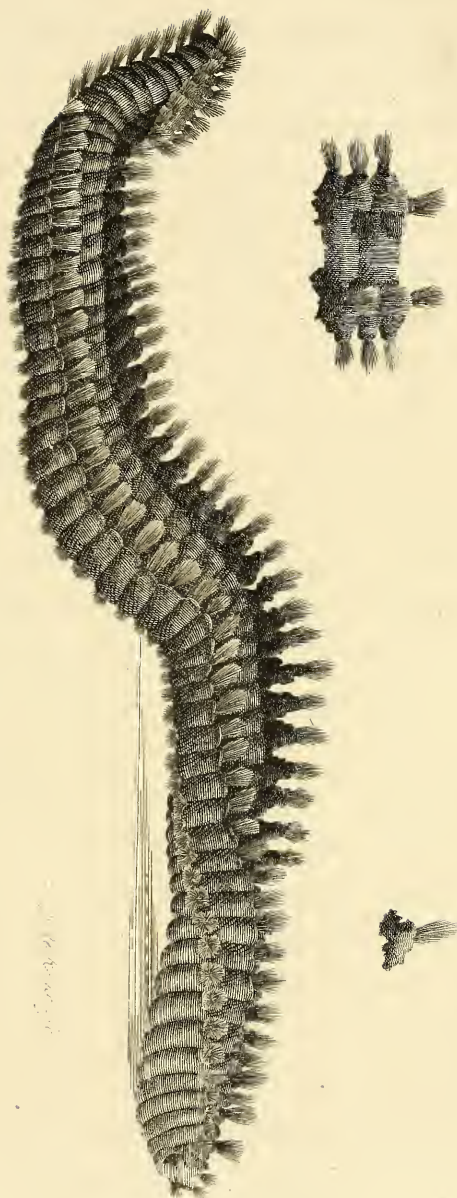
DORIS RADIATA

The marine Genus *Aplysia*, is nearly allied to that of *Limax*, but of a somewhat more complicated structure.

The genus *Doris*, which is also marine, is greatly allied to that of *Limax*, and the species, which are numerous, are often called by the name of *sea-snails*. Among these one of the most common is the *Doris papillosa* of Linnæus; of the size and colour of the brown slug, but covered or bristled over with numerous, soft, pointed processes. The Linnæan species of the genus *Doris* differ so considerably in habit or general appearance in the different tribes, that Monsr. Cuvier and others have instituted for them several distinct genera, instead of grouping them all together, as Linnæus has done. Among the most beautiful is the *Doris radiata* of the Gmelinian edition of the *Systema Naturæ*. It is found in the Atlantic ocean, and is about an inch in length, of a very fine deep-blue colour, accompanied by a silvery lustre, and is distinguished, as a species, by having on each side the body three pair of spreading tufts or processes, of a blue colour, and each consisting of several distinct, diverging rays or fibres. I have before observed that it is not my intention to pass with

punctilious exactness through all the Linnæan genera of the *Mollusca Nuda*, and I shall therefore select only the chief or principal kinds. Some of these genera contain animals of a long worm-like form, and seem, as it were, to connect in some degree the insect tribe with that of the Vermes; since, at first view they much resemble the animals of the genus *Scolopendra* or Centipede among Insects. Of these the genus *Nereis* may be taken as an example. The generic character consists in having a long body, furnished along each side with groups of feather-shaped tentacula, or feelers, according to Linnæus, but which, in reality, are to be considered as so many branchiæ or respiratory organs. The most conspicuous species is the *Nereis gigantea* of Linnæus, measuring from twelve to fifteen inches in length, about three quarters of an inch in breadth, and furnished along each side, from head to tail, with a triple row of the above-mentioned feather-shaped organs. Its colour is brown, with iridescent variations, according to the cast of light. In the Gmelinian Edition of the *Systema Naturæ* of Linnæus this animal is more properly referred to a genus called *Terebella*, and is the *Terebella carunculata* of that edition.

GREAT NEREIS

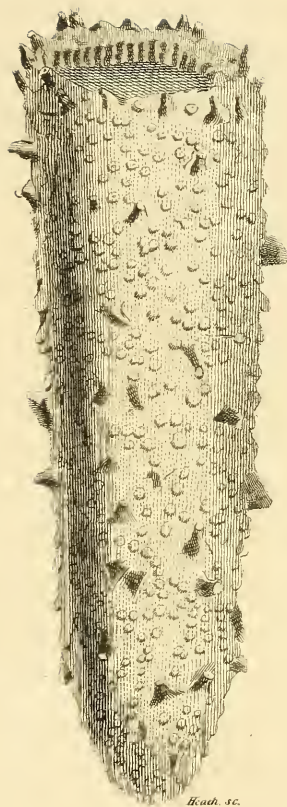


In the Linnæan genus *Nereis* also stands an extremely minute species, so very small as to require the assistance of a microscope in order to be distinctly examined. It has however been raised to a kind of importance from having been supposed by Linnæus the chief cause of the luminous appearance of sea-water by night; since on taking up vessels full of sea-water, when the sea has appeared most brilliant, this microscopic species of *Nereis* has been observed in it in great plenty. The Medusæ however, and a great many other marine animals, are of a phosphorescent nature, and appear luminous during the night, so that the *Nereis noctiluca* of Linnæus cannot be considered as the chief cause of the phenomenon.

This circumstance induces me to mention one of the new genera of marine mollusca lately instituted by the French naturalists, under the name of *Pyrosoma*. It is described and figured in the work entitled “*Annales du Museum National d'Histoire Naturelle*.” This animal, (for there is only one species yet discovered) is of a lengthened and tubular form, open at one extremity, and closed at the other: the body is scattered over with numerous soft papillæ or tubercles, and there is

no appearance of any regular viscera or internal organs, but the whole presents a continued vacuity. The colour of this curious animal, when at rest, is a pale greenish blue ; but when in motion, which is performed by the alternate contraction and dilatation of the body, the whole appears in the highest degree of phosphoric lustre, passing through all the colours of a bar of red-hot iron, till at length it becomes of what is termed a white-heat ; after which it again passes into the colour of red-hot iron, and from that gradually declines into its original greenish hue. The length of this animal is that of several inches, and its diameter about a fourth or fifth of its length. It is a native of some particular parts of the Atlantic Ocean, where it is seen in great multitudes, and irradiates the waves with its fiery brilliancy. Linnæus would perhaps have been inclined to have made it a species of *Holothuria*.

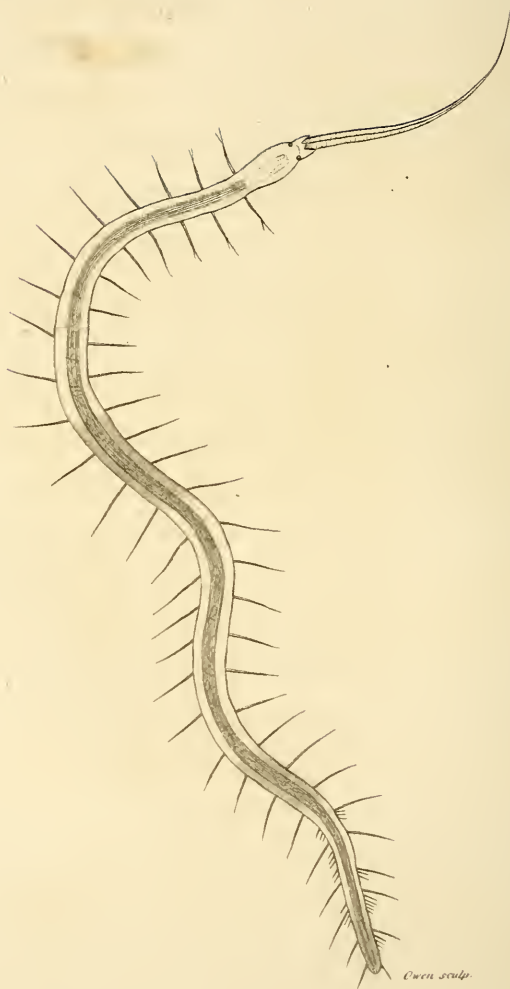
In the enlarged edition of the *Systema Naturæ* by Gmelin, some of the small fresh-water species of the Linnæan genus *Nereis* are more properly referred to a new and distinct genus, under the name of *Nais*. As an example of this genus may be mentioned a very small, transparent, and



Each. sc.

PHOSPHORIC PYROSOMA

1803 Oct. 1. London Published by G. Wearsley Fleet Street.

*Owen sculp.*

NAIS PROBOSCIDEA

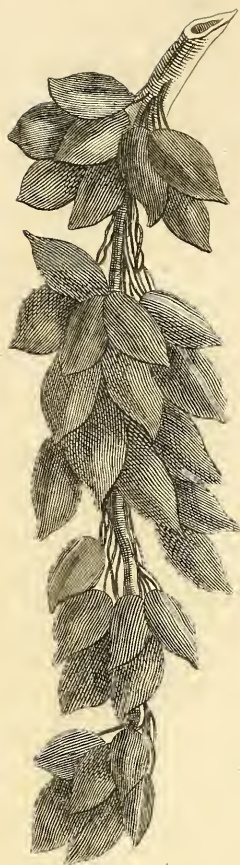
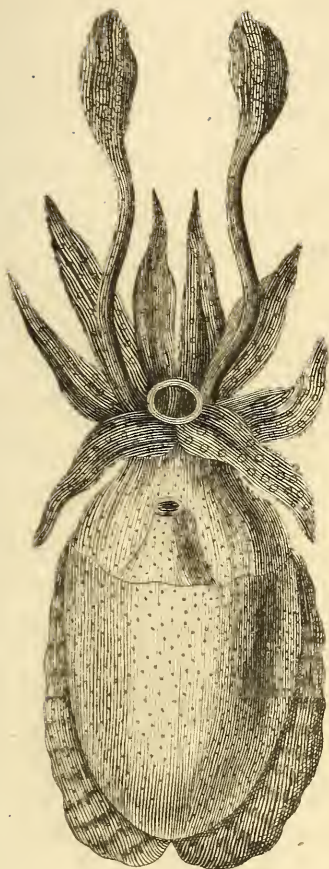
elegantly formed worm of about half an inch in length, not uncommon in stagnant waters, and called the *Nais proboscidea*, or long-snouted Nais, since, if accurately inspected, it will appear to be furnished with a very long, transparent proboscis, which continues always stretched out, the animal being incapable of retracting it. This species, like some other of the smaller Vermes, possesses in a high degree the power of reproduction, and if cut or broken, each part will survive, and reproduce its defective organs.

But, by far the most remarkable of all the Linnean genera of the *Mollusca nuda* or Shell-less Mollusca is that of *Sepia*, in English *Cuttle* or *Ink-Fish*. The genus *Sepia* or *Cuttle* is distinguished by having a fleshy and somewhat lengthened body, seated or enveloped in a kind of sheath, reaching nearly to the head of the animal. The head is furnished with very large eyes, and a horny, central beak, consisting of two mandibles, and resembling that of a parrot. Round the base of the head arise eight long arms, in a radiated direction, and in some species are two additional arms, of a much greater length than the rest. All these arms are beset, on their internal surface,

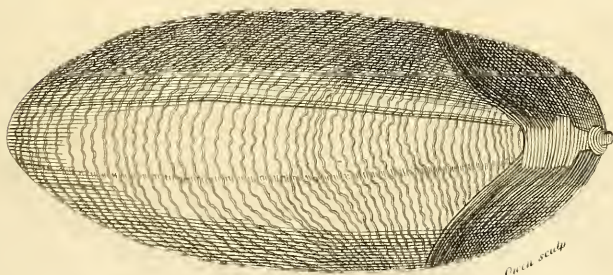
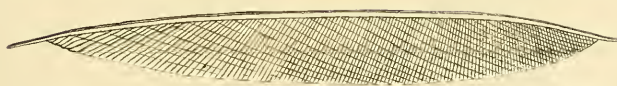
with numerous, round, concave cups, or suckers, which adhere so strongly to whatever substance the animal chuses to attach itself to, as not to be separated without great force.

Exclusive of these characters, the animals of this genus are furnished with an internal pouch or receptacle, filled with a very dark-coloured fluid, in some species intensely black: this fluid they discharge at pleasure through a tubular orifice situated at the base of the breast.

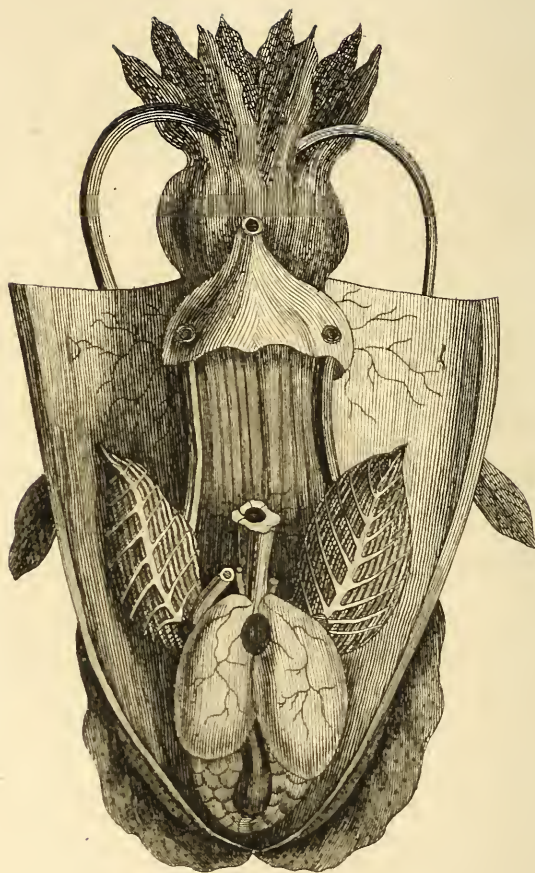
The most common European species of this genus is the *Sepia Officinalis* of Linnæus, generally known by the name of the *Cuttle-Fish*. This animal, which, at its full growth, measures about two feet in length, is of a pale bluish-brown colour, with the skin marked by numerous dark-purple specks. Imbedded in the back or fleshy part of the body of this species is always found a large oblong-oval, calcareous bone, of a cellular texture, and which is of so light a nature as to float in water. It has been supposed that the animal has the power of filling the minute cellules of this bone with air, or of exhausting them of it at pleasure, in order to ascend or descend with the greater facility. This bone of the *Cuttle-Fish* is often

or Common Cattle Fish

*Eggs of d'c popularly called
Sea Grapes*

*Cover scalp*

*Calcareous bone of d'c with
a longitudinal section of the same*



Omen sculp

CUTTLE FISH

laid open

found in considerable quantities, cast on the shores, and forms a small article of commerce, being used for various purposes by different artificers. It also serves, when reduced to powder, as a good common dentifrice, and is indeed considered as one of the most innocent that can be used for that purpose.

The anatomy of the Cuttle-Fish is highly curious, and has long ago been detailed by Swammerdam and others; and was even not unknown to the ancients. The animal is furnished with a pair of large lungs or respiratory organs, situated nearly as in quadrupeds, but they are constituted on a different principle, and are more allied to the gills of Fishes. The most striking particularity however in this animal is that of having three distinct hearts: these are situated in the form of a triangle, and the lowest of the three is larger than the rest. The eyes, which in this whole genus are remarkably large, are covered, as in Eels and some other fishes, by the common skin, which is transparent in those parts. The pupil of the eye appears double, and the internal cavity of the eye is lined with a purplish-coloured mucus, which causes the eyes of the living animal to appear phosphoric or

fiery in a high degree: the exterior coat or ball of the eye is remarkably strong, so as to seem almost calcareous, and is when taken out of a brilliant pearl-colour; and they are worn in some particular parts of Italy, and in the Grecian islands by way of artificial pearls in necklaces. The Cuttle-Fish, like the rest of its tribe, is of a predacious nature, and feeds on fishes, shell-fish, and other marine animals, and is, no doubt, a highly formidable adversary; since it possesses the power of fastening itself so closely by the assistance of the suckers or cups of its arms, that no animal, unless of very considerable size and strength, can be supposed to liberate itself from its grasp. Its favourite residence is between the vacuities or clefts of submarine rocks, where it is generally sure of meeting with plenty of food, and, in defect of which, in such situations, it occasionally sallies out into the ocean in pursuit of prey. During these excursions, on the approach either of danger to itself, or the more easily to prevent the escape of its intended prey, it discharges, from the tubular orifice at the breast, a quantity of the black fluid with which it is always amply provided; and thus obscures or darkens the water to a great dis-

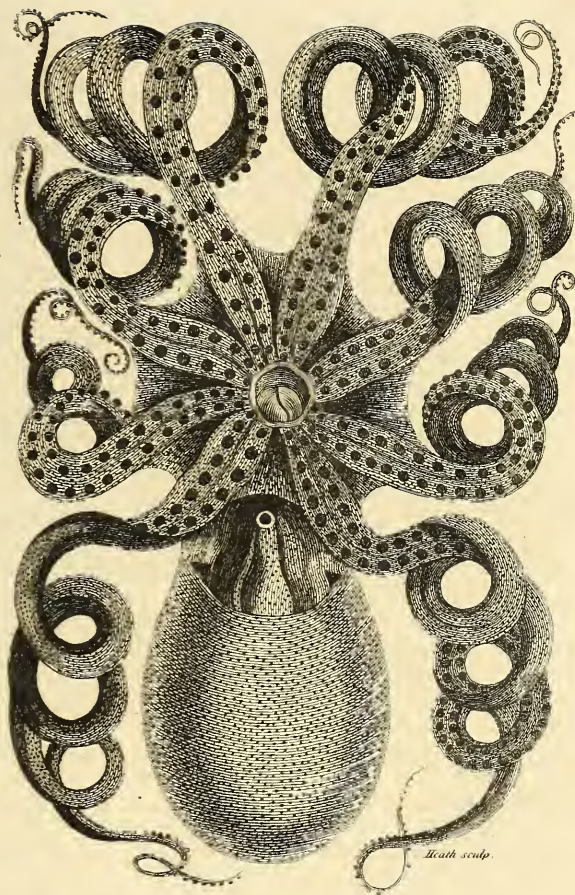
tance round. This practice of the Cuttle-fish was well known to the ancients. Our own celebrated countryman, Mr. Ray, draws from this circumstance a singularly apposite and witty illustration; and observes that an obscure and prolix author may not improperly be compared to a Cuttle-Fish, since he may be said to hide himself under his own ink! The black liquor or ink of the Cuttle-Fish, when collected, and dried, splits or cracks into fragments, which being then ground down, and redissolved in water, form an exquisite Ink, of the most durable blackness; and the well-known Chinese preparation, commonly called Indian-Ink, is, in reality, supposed to be no other than the concrete juice of the Cuttle-Fish, carefully managed, perfumed, and at length formed into the ornamented cakes or masses in which we receive it. I should here observe that all the species of the genus *Sepia* are provided with a similar fluid, which they use for similar purposes; but that of the Common Cuttle-Fish is of a deeper or blacker colour than in most other kinds. In some species it is of a reddish-brown colour, and from it is prepared by the Chinese the brown and reddish-brown varieties of Indian-Ink which are sometimes seen.

The Ancient Romans, as appears from several passages in their writings, made use of the juice of the Cuttle-Fish by way of an ink, but they seem to have been unacquainted with any other mode of preparing it than that of merely mixing or dissolving it in water. The female Cuttle-Fish deposits its eggs in numerous clusters, on the stalks of fuci, on corals, about the projecting sides of rocks, or on any other convenient substances. These eggs, which are of the size of small filberds, and of a black colour, are popularly known by the name of *sea-grapes*: each individual egg is of an oval shape, but with a somewhat sharpened point; the young proceeds from it complete in all its parts, and differing from the parent animal in no other respect than that of size.

The *Calamary*, *Loligo*, *Pen-Fish*, or *Ink-Fish*, is a species scarcely less remarkable than the preceding. It is of a much more lengthened shape, of a darker colour, and with the two long additional arms of greater length in proportion; and on each side the tail is an expansion or process, forming a kind of short triangular fin. This animal is also an inhabitant of the European seas, but is less common than the Cuttle-Fish. It has the same

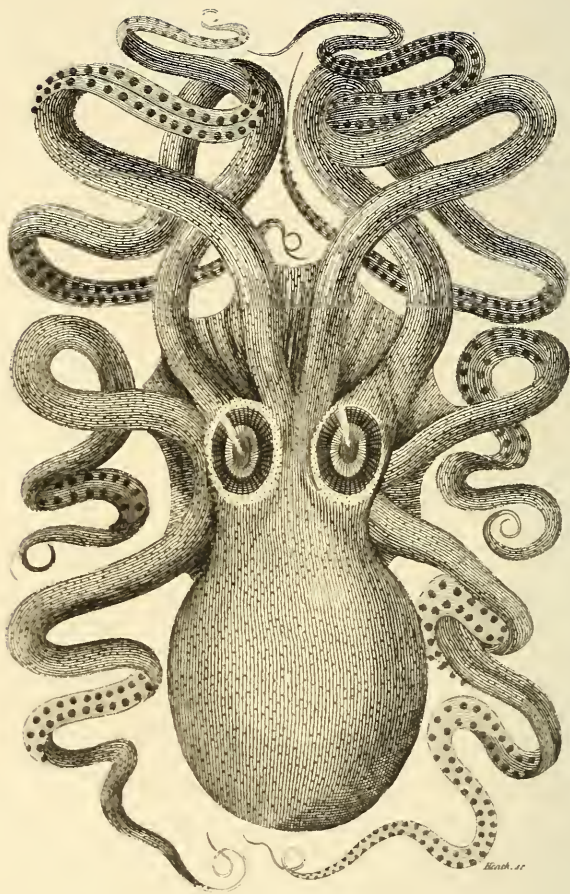
habit of occasionally darkening the water by the discharge of its ink. Instead of the remarkable calcareous bone belonging to the common Cuttle-Fish, we find in the Calamary a long, thin, transparent, pen-shaped cartilage, of a curious appearance, pointed at the tip of the dilated part, and semicylindrical at the other end, somewhat representing the stem of a quill. This is supposed to be the reason of the name of *Calamary*, applied to this species. Its general habits are very similar to those of the Cuttle-Fish. It is a very prolific animal, and the eggs are of a very singular and curious appearance: they are deposited in the form of numerous lengthened groups, radiating from a common centre, and spreading every way into a circular form: each egg is of a glassy transparency, and the young animal may be very distinctly observed in each, many days before the period of exclusion. These groups of the eggs of the Calamary are often seen swimming on the surface, and are occasionally thrown on shore; the whole groupe sometimes measures more than a foot in diameter, and from its general appearance, unless closely inspected, is often mistaken for a species of Medusa or Sea-Blubber.

A more remarkable species than either of the preceding is the Eight-Armed Cuttle-Fish, or *Sepia Octopodia* of Linnæus. This animal has a short, oval body, surrounded at the upper part by an expansile membrane, into the sides of which are inserted the arms, which are of great length, beset on the inside with a double row of suckers or holders, and are all of equal length, or without an additional long pair as in the two preceding species of this genus. The eight-armed Cuttle-Fish, when at full growth, may be considered as a very formidable animal, and possesses such a degree of strength as to make it dangerous to attack it without great precaution. Such is the ferocity and violence with which it defends itself, that even the strongest Mastiff can hardly subdue it without a long and doubtful contest. It has even been known to attack a person while swimming, and to fasten itself with dangerous force round the body and limbs. It is supposed that there is something more than a mere power of adhesion in the acetabula or concave suckers or fasteners with which the arms of this animal are beset; something of an electric or galvanic nature; since the pain which their application causes does not soon cease after



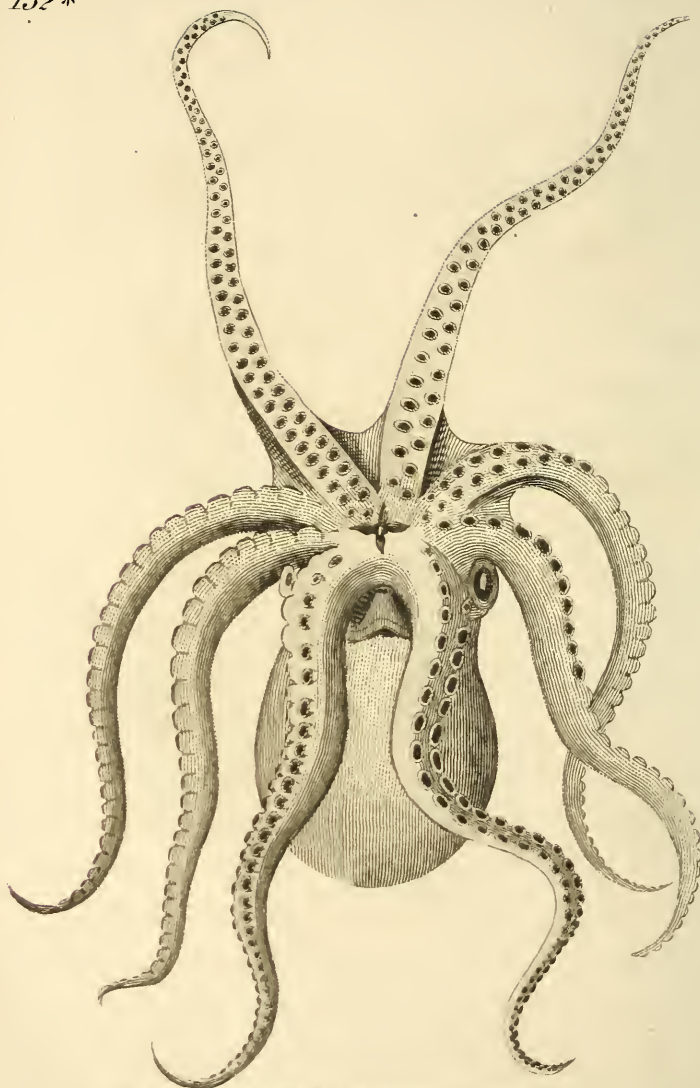
EIGHT ARMED CUTTLE FISH
viewed in front





EIGHTARMED CUTTLE FISH
viewed from behind

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EIGHT ARMED CUTTLE FISH *var.*
viewed in front, with outline of the beak.

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the removal of the animal ; a kind of stinging or urtication remaining for many hours, and long after this, a troublesome irritation and itching.

This species arrives at a very large size, being often seen so large that the body equals the size of a gourd, while the arms measure from three to four feet in length, and from nine to twelve in circumference when spread out in the form of a star, which is a posture in which the animal frequently places them. It resides in the deep channels formed by large rocks, and is generally seen in pairs. The male is said to wander about in quest of prey to a certain distance from its recess, while the female rarely wanders from it. The eggs of the Eight-Armed Cuttle-Fish are extremely numerous, and are disposed in a kind of grape-like cluster : they are of a glassy transparency, so that the young animal, as in those of the Calamary, may be seen in them long before the time of its exclusion.

The Sepiæ or Cuttle-Fish in general, were often called by the ancients by the title of Polypi, on account of their numerous limbs : they also possess, like the Polypi of modern Natural History, a considerable degree of reproductive power ;

being often seen with limbs which have evidently been mutilated, and have reproduced.

The Eight-Armed and common Cuttle-Fish are numbered among the edible marine animals, and are still used in many parts of Europe as a food. With the Romans they seem to have been considered as a delicacy. When boiled, they assume a red or deep salmon-colour, especially when salted. The Greeks as well as the Romans are known to have been in the habit of using the Cuttle as a food, and it has been supposed, and surely not without a considerable degree of probability, that the celebrated plain, but wholesome dish, the black broth of Sparta, was no other than a kind of Cuttle-Fish soup, in which the black liquor of the animal was always added as an ingredient; being, when recent, of a very agreeable taste.

Mr. Pennant, in the fourth volume of his *British Zoology*, speaking of the Eight-armed Cuttle, tells us, he has been well assured from persons worthy of credit, that in the Indian seas this species has been found of such a size as to measure two fathoms in breadth across the central part, while each arm has measured nine fathoms in

length; and that the natives of the Indian isles, when sailing in their canoes, always take care to be provided with hatchets, in order to cut off immediately the arms of such of those animals as happen to fling them over the sides of the canoe, lest they should pull it under water and sink it. This has been considered as a piece of credulity in Mr. Pennant, unworthy of a sober naturalist. It is certain however that a great variety of apparently authentic evidences seem to confirm the reality of this account. The ancients, it is evident, acknowledged the existence of animals of the Cuttle-Fish tribe of a most enormous size; witness the account given by Pliny and others of the large *Polypus* as he terms it, which used to rob the repositories of salt-fish on the coasts of Carteia, and which, according to his description, had a head of the size of a cask that would hold fifteen amphoræ; arms measuring thirty feet in length, of such a diameter that a man could hardly clasp one of them, and beset with suckers or fasteners of the size of large basins that would hold four or five gallons apiece. The existence in short of some enormously large species of the Cuttle-Fish tribe in the Indian and northern seas can hardly be

doubted; and though some accounts may have been much exaggerated, yet there is sufficient cause for believing that such species very far surpass all that are generally observable about the coasts of the European seas. A modern naturalist chooses to distinguish this tremendous species by the title of the Colossal Cuttle-Fish, and seems amply disposed to believe all that has been related of its ravages. A northern navigator of the name of *Dens* is said some years ago to have lost three of his men in the African seas, by a monster of this kind, which unexpectedly made its appearance while these men were employed, during a calm, in raking the sides of the vessel. The Colossal Cuttle-Fish seized these men in its arms, and drew them under water, in spite of every effort to preserve them: the thickness of one of the arms which was cut off in the contest was that of a mizen-mast, and the acetabula or suckers of the size of pot-lids.

But what shall we say to the idea of a modern French naturalist, who is inclined to suppose, that the destruction of the great French ship the *Ville de Paris*, taken by the English during the American war, together with nine other ships which

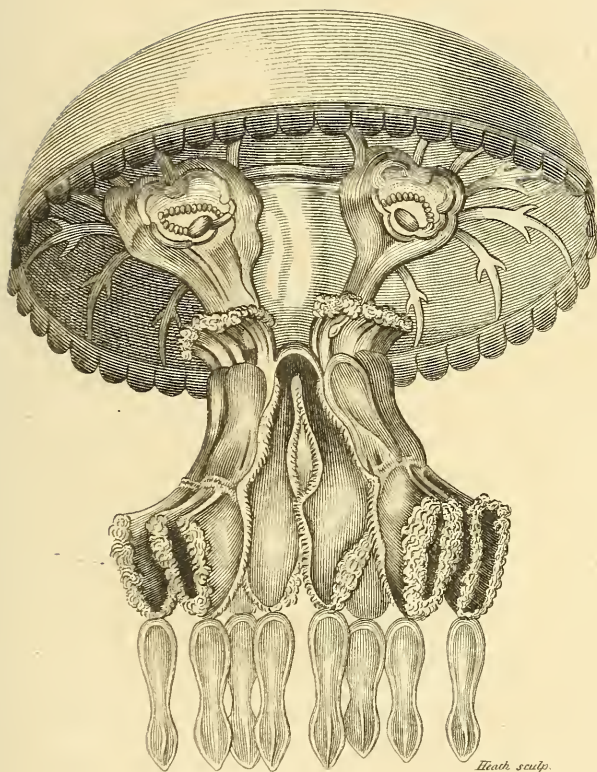
came to her assistance on seeing her fire signals of distress, was owing, not to the storm which accompanied the disaster, but to a groupe of Colossal Cuttle-Fishes, which happened at that very time to be prowling about the ocean beneath these unfortunate vessels?

These accounts, whether true or false, naturally recal to our recollection the far-famed monster of the Northern seas, often mentioned in a vague manner under the name of Kraken or Korven. The general tenor of these accounts is, that in some parts of the Northern seas, during the heat of summer, while the sea is perfectly calm, a vast mass, resembling a kind of floating island, about a quarter of a mile in diameter, is seen to rise above the surface: appearing to be covered with a profusion of sea-weeds, corals, and other marine substances. When it is fully risen, it seldom fails to stretch up several enormous arms, of such a height as to equal that of the masts of a ship; and after having continued in this position for some time, it again slowly descends. From the general description thus given of its shape, it has been supposed that it is a species of Sepia or Cuttle-Fish. Linnæus, in the first edition of his

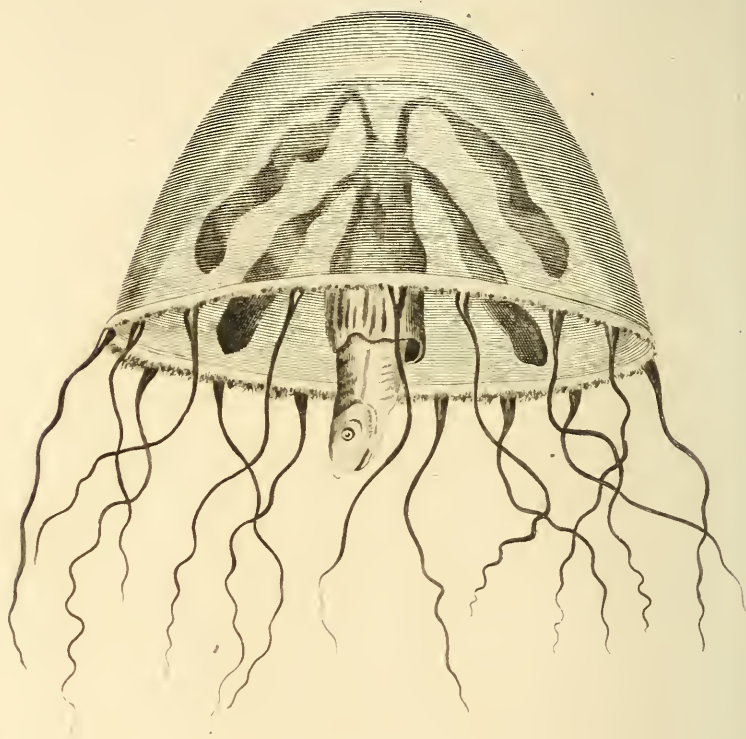
work entitled *Fauna Suecica*, as well as in the earlier editions of his *Systema Naturæ*, seems inclined to admit the existence of this animal, and forms a genus for it under the name of *Microcosmus*.

The genus *Medusa* contains a very remarkable set of marine animals, which are generally characterized by their soft and almost gelatinous substance, their rounded and somewhat flattened shape, their semitransparency, and their numerous arms or tentacula. The species of this genus are extremely numerous, and often present an appearance in the highest degree elegant and singular. They are of various sizes, some measuring one or two, or even three feet in diameter, while others are of a size so diminutive as scarcely to equal half an inch in diameter. One of the most remarkable of the larger kinds is the *Medusa Pulmo*, which is seen in many of the European seas, and is most common about the coasts of Italy and Sicily. It measures from one to two feet in diameter: the body is nearly hemispherical, concave beneath, notched into several very slight or shallow divisions round the edge, and furnished beneath with a very large and curious apparatus, consisting

MEDUSA PULMO



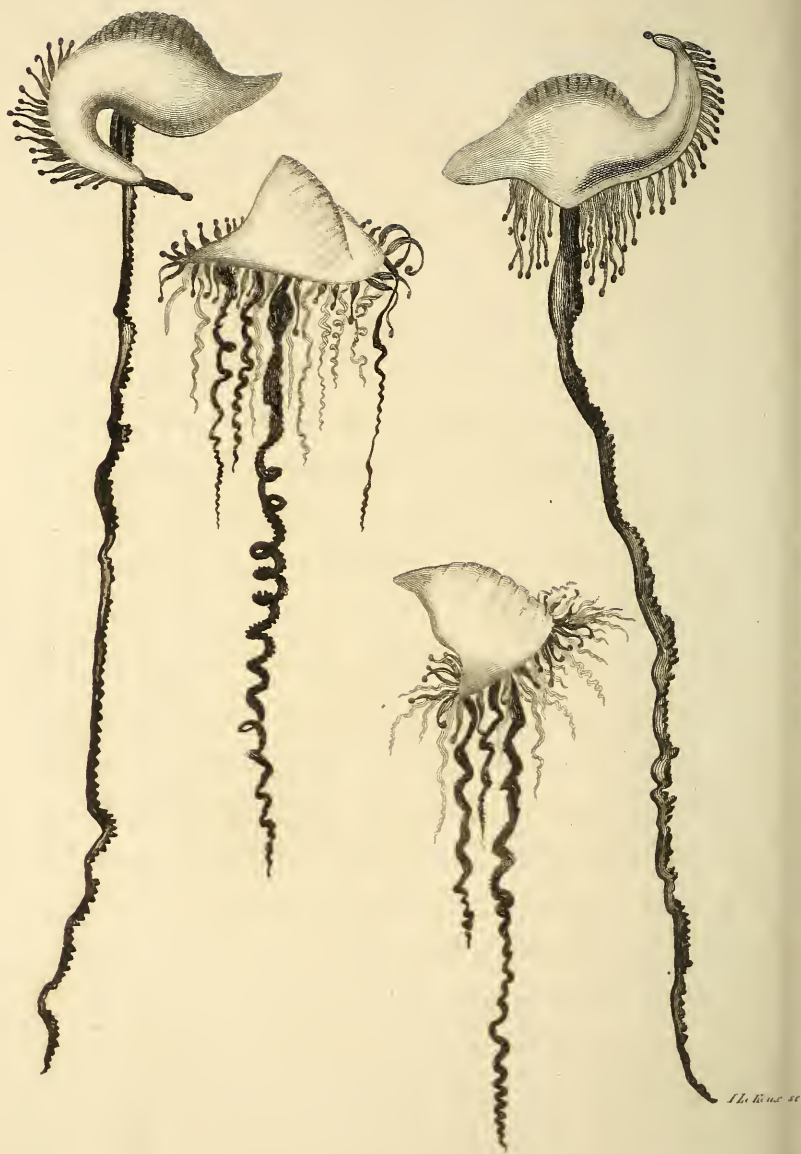
MEDUSA CAMPANELLA
or Bell Medusa in its natural size & magnified



of eight limbs or arms, springing from a central trunk, dividing into eight large wrinkled lobes, which are tipped with so many lengthened sub-triangular processes. The whole animal is of a glassy transparency, and very much resembles the appearance of a chandelier or glass lustre. The Medusæ in general are with extreme difficulty preserved in their natural appearance, either in spirits, or by any other method, and many of them have been but very imperfectly described and figured in the works of Naturalists. The Medusa Pulmo, which I have just mentioned, has been very accurately and elegantly described and represented by Dr. Macri, an Italian physician, who many years ago published its description. The species of Medusæ differ very much in habit from each other; insomuch that several distinct genera might be instituted from the single Linnæan genus Medusa. Many species are highly phosphoric, and shine during the night with a very brilliant lustre. They are of a predacious nature, and live on the smaller kinds of fishes, and other marine animals, which, notwithstanding their apparently tender nature, they are enabled to seize

with their arms or tentacula, and to absorb by means of their mouth or central orifice. They are probably viviparous animals; they are in general called by the popular title of sea-blubbers, and are sometimes so very numerous as to float by thousands on the surface of particular parts of the sea.

Another very singular genus is that of *Holothuria*, of which the characters are, an oblong, nayant or floating body, furnished at one extremity with several arms, feelers, or tentacula, surrounding the mouth or opening. I shall here observe, once for all, that many of the Linnæan genera of the Mollusca are capable of considerable improvement, and that he has somewhat too frequently associated under one genus, animals not sufficiently resembling each other in habit or general appearance. The most common perhaps of the European species of the present genus is the *Holothuria tremula*; an animal of a lengthened, cylindric form, of a purplish-red colour, and beset on all sides with very numerous soft tubercles of different sizes; and furnished at its upper end, round the mouth, with numerous short but cu-



HOLOTHURIA UTRICULUS

*An elegant species of a Sea green colour varied with purple
& with very long deep blue tentacula*

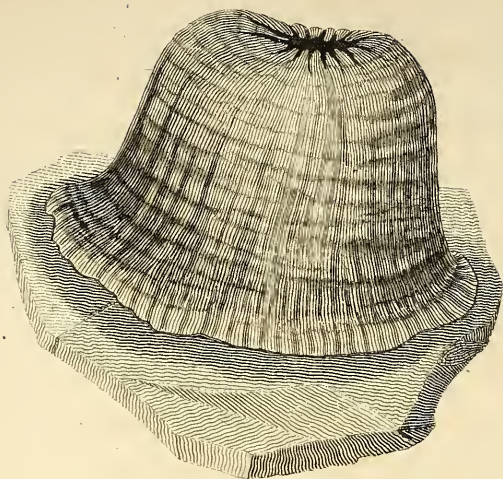
riously branched arms, forming the appearance of so many clusters: the animal is chiefly a native of the northern seas.

A much more remarkable species is the *Holothuria Physalis* of Linnæus, generally known to sailors by the name of the Portuguese Man of War. It may be considered as one of the most curious of all the Mollusca, and resembles in shape an oblong transparent bladder, several inches in length, sharp at one end, and somewhat rounded at the other; of a pale purple colour, with deeper veins or ramifications: along the upper part runs a slightly elevated ridge or crest, somewhat undulated or notched on the outline, while from beneath the large or obtuse end of the animal hang down, in a perpendicular direction, a great many string-shaped feelers or processes of a deep purple colour, and of different lengths: lastly, the edges of the body beneath, are surrounded by a series of short or abrupt processes of a deep purplish-brown colour. The appearance of the whole is in the highest degree singular and elegant. From having examined a very fine drawing of this animal, in its living or recent state, by an artist of great talent, I am enabled to give its description with

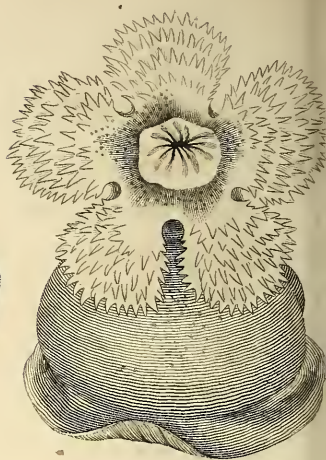
sufficient accuracy. The figures hitherto given, such as that in Sloane's Jamaica, and some other works, exhibit only a general similitude. It is often confounded with a different species, resembling it in some degree, but of a much longer or more slender form, and of a greenish colour, with numerous yellowish-brown tentacula, among which are two or three central ones far exceeding the rest in size and length; of a wrinkled or annulated appearance, and of the richest deep-blue colour. The real structure or anatomy of these vesicular *Holothuriæ* seem as yet but very imperfectly understood. They are observed to float occasionally, during fine weather, on the surface of a calm sea, and when taken, have the power of inflaming the skin to a considerable degree, if incautiously handled.

The beautiful genus *Actinia*, from its flower-like appearance when expanded, called the *Sea-Anemone*, is characterized by having an oblong body, of an extensile and expansile nature, and adhering by the base to rocks or other marine substances. The mouth is situated in the centre of the upper part or disc, and is surrounded by very numerous, soft, extensile feelers or arms,

ACTINIA VARIA



ACTINIA DIANTHUS



ACTINIA CERES
 — or —
 Rose-tipped Actinea

spreading in the manner of rays, and disposed in a single, double, or triple series, according to the different species. The Actiniæ are very common on the rocks of most of the European coasts: when in their contracted state, they have the appearance of inanimate, rounded masses of coloured pulp or flesh; and when expanded, they greatly resemble the appearance of an expanded polypetalous flower, particularly those of the Anemone and Ranunculus tribe. One of the most common British species is the *Actinia varia**, found on most of our coasts, and varying ad infinitum in its colours, being either red, olive, green, of different shades, and either plain or variously spotted: its principal character, and which distinguishes it in whatever variety of general colour it may happen to appear, consists in a row of short bead-like prominences, surrounding the external row of tentacula: these bead-like processes are invariably of a bright blue colour. The *Actinia varia* S. S. in general measures about two inches in diameter at the base, but is occasionally seen of far larger size.

A more beautiful species is however found on

* Act. Mesembryanthemum. Ellis. Gmel. Syst. Nat.

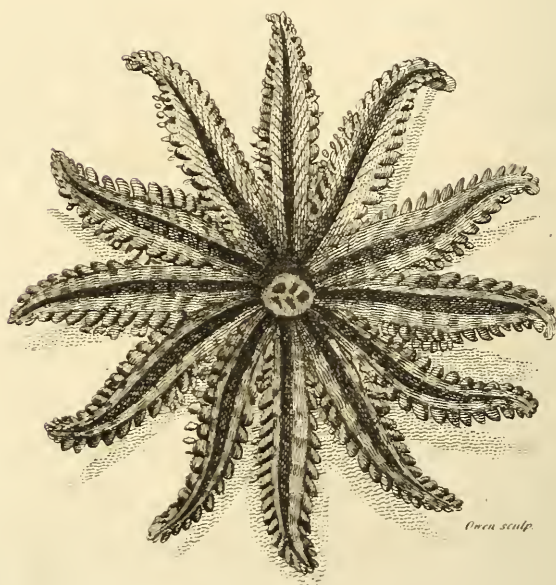
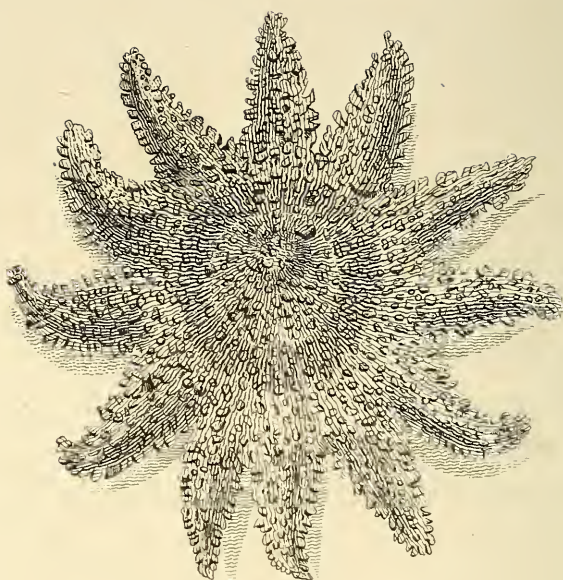
our own coasts ; generally imbedding itself in the sand, instead of adhering to rocks ; it is called the *Actinia crassicornis*, and is distinguished by its red colour, and roughish external surface, while the central or middle part, when expanded, is white, most elegantly marked near the base of the tentacula with numerous carmine-coloured streaks : the tentacula themselves being of a pearl-colour, and of a much thicker or more swelled appearance than in most other species. The *Actinia crassicornis* often measures four, five, or even six inches in diameter when in its expanded state.

The Actiniæ or Sea-Anemonies are naturally very voracious animals, preying not only on the softer sea-animals, but on such as are guarded by a shelly defence ; they swallow various kinds of univalve shell-fish, the smaller kind of crabs, and other animals, and when they have absorbed the juices of their prey, they reject the shell or other integument by the mouth. When kept in vessels of sea-water, which may be easily practised, they seem to require no particular nutriment, absorbing a sufficient quantity of animal gluten from the sea-water itself for all the purposes of nutrition. In this confined state they do not grow or increase

in size, though they frequently produce a numerous offspring, being of a very prolific nature, and viviparous. The young are produced of various sizes, from that of a pin's head to that of half an inch in diameter, and to the number of five, ten, or more at a birth. As these animals are allied to the Polype tribe in some degree, they partake of their qualities, and will reproduce many of their organs, when either purposely or accidentally mutilated.

The minuter genera of the Mollusca it would be tedious and uninteresting to particularize in the course of a lecture, but the larger and more remarkable ones justly demand our attention. Of these the genus *Asterias* or *Star-Fish* is one of the chief: it is rather of a coriaceous or crustacean nature than of that soft cast so common to many other of the Mollusca. The generic character consists in having a depressed body, covered by a coriaceous or tough integument, roughened by very numerous small processes or tentacula. The mouth is central, and situated beneath. By far the greater number of the Sea-Stars or *Asteriæ* are of a stellated or radiated shape; several lengthened arms or limbs proceeding from the common body or central part, so that the animal represents

the form of a star, as vulgarly painted. In some the rays or limbs are few in number, and in others numerous: in the more simple species the prevailing number of the rays is five; in others ten, or twelve. In some the rays, instead of being broad or thick at the base, are throughout extremely narrow; and lastly, some are of a compound and very numerous-ramified appearance. Several are natives of the European seas, but the most striking are of exotic origin. Many have been admirably figured in the work of Seba, and many in that of Link, an author who wrote a work on this genus in particular, accompanied by very numerous plates. As the strong and almost crustaceous skin of these animals admits of their being easily preserved in their natural appearance, they are frequently seen in collections, and many of the most rare and curious species may be found in the British and Leverian Museums. Of the simpler kinds, or those with large, thick rays, the *A. reticulata* is one of the largest, and most elegant; it often measures a foot in diameter, and is of a yellowish red colour, with the upper surface curiously tuberculated, and the margins of the rays jointed in such a manner as to appear as if artificially carv-



ASTERIAS PAPPOSA

or Twelve rayed Star Fish

ed ; while the whole surface of the body is marked into numerous, slightly-prominent, reticular spaces of a triangular figure. It is a native of the Indian seas.

The *Ast. Gigas** is of similar size and colour, and is all over roughened by small pointed protuberances, which also verge the margins of the rays : it is a native of the Atlantic, and is well figured in the magnificent work of Seba.

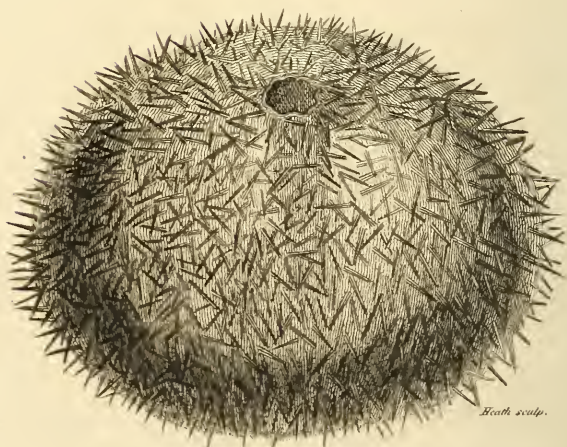
Of the British species the *A. papposa* or common twelve-rayed Star-fish is a good example. Its colour is a dark yellowish red, and its surface roughened by very numerous small protuberances. Its usual number of rays or limits is twelve, but it varies, from ten or eleven, to thirteen or even fifteen.

The most curious of the whole tribe is the *A. Caput Medusæ* of Linnæus, or Medusa's Head Star-Fish. It grows to a large extent, measuring more than two feet in diameter when the limbs are fully extended. This very extraordinary animal is first divided into five equidistant, jointed processes, each of which is soon subdivided into

* *A. Gigas*.? Mus. Tessin. pl. 9.

two other smaller ones ; and each of these, at a somewhat farther distance, into two others, still smaller ; this mode of regular subdivision being continued to a vast extent, and in the most beautiful gradation of minuteness, till at length the number of extreme ramifications amounts to several thousands. By this most curious structure, the animal becomes, as it were, a kind of living net, and is capable of catching such creatures as are destined for its prey, by the sudden contraction of all its innumerable ramifications, and thus the object is secured beyond all power of escape. For examples of this animal I must refer to the British and Leverian Museums.

The Sea-Stars in general have a very considerable degree of reproductive power, and if injured by accidental violence, or if one or more of the limbs be cut or torn off, the animal will in time be furnished with new ones. They wander about the ocean in quest of prey, more particularly near the shores, and feed not only on the softer sea-animals, but on the smaller shell-fish. Their mouth, which, as I before observed, is situated beneath, is armed with hard and sharp teeth, resembling a kind of spines, and converging towards the centre

*Booth sculp.*

ECHINUS ESCULENTUS
or Common Sea Urchin

1808 Oct. 1. London Published by G. Kearsley Fleet Street.

of the mouth, and differing in number in the different species. I should not omit to observe that the curious species last mentioned, the Medusa's Head Star-Fish, is chiefly confined to the Indian seas, but is sometimes found in those of Europe. Those who may wish for a particular description of the anatomy of the Star-fishes, may consult the observations of Reaumur on this subject, published in the Memoirs of the French Academy.

The concluding genus of the Linnæan *Mollusca Nuda*, or such as have not a true shelly integument, is called *Echinus* or *Sea-Urchin*. Its appearance is remarkable, the body, which is soft, being inclosed in a thin, calcareous crust, which is thickly beset with spines, of different length in the different species, which are extremely numerous, and vary considerably in habit or general appearance from each other. The mouth in this genus is central, placed beneath, and furnished with five strong, converging, bony teeth or spines. The most familiar example of the genus is the common or edible Sea-Urchin; the *Echinus esculentus* of Linnæus, so very frequently seen on many of our own coasts. Its shape is nearly globular, but slightly flattened beneath, and some-

times measures four inches or more in diameter. The body, or soft part within the shell, is marked, as it were, into a kind of lobes or divisions, not much unlike those of the pulp of an orange ; the intestines are disposed in a somewhat circular direction, and the whole body is internally supported by a set of upright bony columns. On the outside of the shell, which is generally of a dull violet-colour, and sometimes greenish, are seated a prodigious number of sharp, moveable spines, curiously articulated with the tubercles of the surface, and connected by strong ligaments. These spines are the instruments of motion, by the assistance of which the animal conveys itself at pleasure to any particular spot ; and so tenacious are they of the vital principle, that, on breaking the shell, the several fragments have been sometimes seen to walk off in different directions. Between the spines, disposed in continued longitudinal rows or series, on the different divisions of the shell, are an infinite number of small holes, communicating with tentacula or feelers placed above them : these feelers are the instruments by which the creature fixes itself at pleasure to any object, and stops its motion : they are possessed of a very

high degree of contractile power, and are furnished at the extremity with a slightly expanded tip, which acts as a sucker or fastener. By these feelers also the Echinus takes its prey, fastening easily on any small shell-fish in its way, and securing it, by applying to the shell the tips of its feelers and dragging it to its mouth. This species is considered as no unpleasant article of food, and was a dish well known to the ancient Romans. The internal structure of the spines, if closely examined, will be found to bear a considerable resemblance to those of the hedge-hog, the general structure being the same in both, though the one is of a horny, and the other of a calcareous substance. To particularize the Exotic Echini would be an endless task. Among the most remarkable species is the flattish-bodied Indian Echinus, with extremely large, thick, club-shaped spines, of a violet colour, barred with white. This curious species, with several of its most remarkable varieties, occurs in the highest perfection in the Leverian Museum. The shells of the Echini in general, when dried, and divested of their spines, generally present a very elegant and beautiful appearance, the pattern of the jointed subdivisions

of the shell or crust varying in the different species, and the general colour being of a reddish or yellowish cast. We may observe here, that many different species of this genus occur very frequently in a fossil state; sometimes imbedded in chalk, and sometimes in flint.

I have now passed through the chief tribes of the *Mollusca nuda*, or the Soft-bodied animals destitute of a stony shell; and shall in my next lecture proceed to the shelly or testaceous tribe.

LECTURE XI.

THE Linnæan *Mollusca Testacea*, or *Soft-bodied Animals furnished with Shells*, are divided into three assortments, called *Univalves*, *Bivalves*, and *Multivalves*; meaning, that the shelly cover consists either of *one*, *two*, or several parts or valves.

A *Univalve Shell* may be exemplified by that of the common snail; for the shell is simple or undivided. A *Bivalve Shell* may be exemplified by a *Muscle*, in which, as every one knows, the shell is composed of two pieces or valves; and lastly a *Multivalve Shell* may be exemplified by any species of *Lepas* or *Bernacle*, in which the shelly covering of the animal is formed of several pieces or divisions.

The animals inhabiting by far the greater part of the *Univalve shells* are formed on the plan of the common *Garden Snail*, to which they bear a great general resemblance, though furnished, in

the different genera, or sets, with some particular parts or organs not to be observed in Snails ; and the Snails themselves are formed on the plan of the genus *Limax* or Slug, which, as I mentioned at our last meeting, may be considered as the archetype or pattern of most of the animals of the univalve shells.

The animals inhabiting the bivalve shells are formed on a different plan, and, except in a few particular instances, bear a general resemblance to the animal of the muscle and the oyster, and are closely allied to the Linnæan genera of the Naked Mollusca called *Tethys* and *Ascidia*.

The animals of the Multivalve Shells vary considerably in their structure ; for while some are shaped like the animals of the Bivalves, others are formed like those of the major part of the Univalves ; that is they have a snail-like shape ; and lastly, others are of a habit or appearance totally differing from any of the Univalve or Bivalve tribes, and peculiar to themselves and to the genus *Triton* among the naked Mollusca.

The most striking deviation from the general plan of Nature in the Univalve shells is exhibited in the Linnæan genus *Argonauta* or Argonaut ;

the principal species of which are inhabited by animals of an appearance so widely remote from that of the rest of the shell-tribe, and so closely allied to the genus *Sepia* or Cuttle, as scarcely to differ except in the circumstance of having two of the arms furnished towards the tip with a very large, expanded, oval membrane, by the assistance of which it is enabled to sail along the surface of the sea, when calm, in any particular direction, and on the least appearance of danger to submerge itself by suddenly contracting its webbed arms, and withdrawing them into the shell.

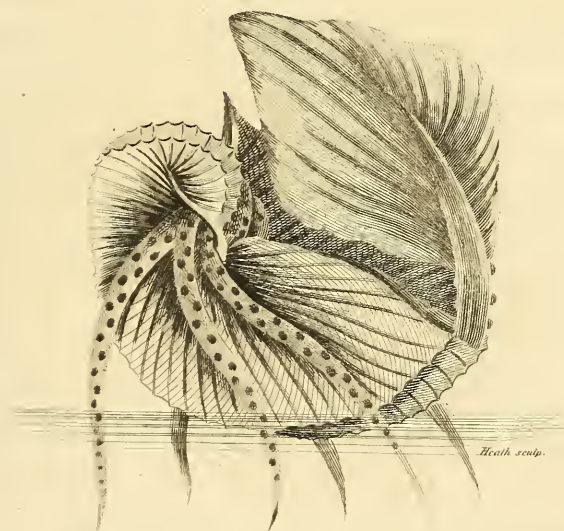
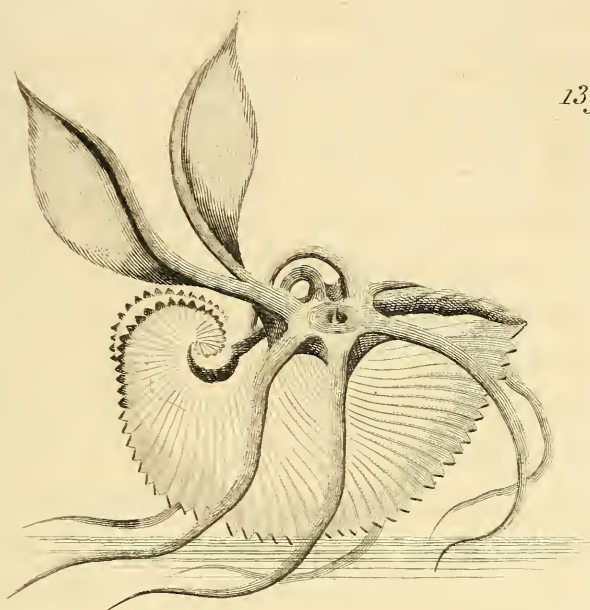
The principal species of the genus *Argonauta*, the first of the Univalves in the Linnæan arrangement, is well known to the shell-collectors by the name of the *Paper Nautilus*. This shell, which grows to a very considerable size, sometimes measuring near ten inches in length, is of an appearance uncommonly elegant, representing a kind of boat or vessel, of a slightly compressed shape, gradually widening towards the tip or mouth, and turning up at the back part into a spiral curvature. The whole shell, which is scarcely thicker than common paper, of a white colour, and semitransparent, is marked throughout its

whole surface by very numerous, deeply-impressed, obliquely-descending furrows ; and the keel or bottom is tuberculated along each side by the projecting tips of the furrowed part of the shell. This shell, with its inhabiting animal, sailing along the surface in fine weather, has from very remote times attracted the admiration of mankind, and has been celebrated as having given the first hint for the practice of navigation, as if man, with all his powers of mind, was unable to conceive the possibility of swimming or sailing in a boat upon the water, without first receiving a hint from the inhabitant of a shell ! This is the species to which the well-known lines of Pope allude, and which have been so often quoted on the subject, that notwithstanding their real beauty, they may be considered as almost vulgarized by frequent repetition.

“ Learn of the little Nautilus to sail,

“ Spread the thin oar, and catch the rising gale.”

As the animal which thus sails in the shell called the Paper Nautilus is not fastened to the shell by any connecting tendon, like the rest of the testaceous tribe, but has the power of leaving the shell at pleasure, and as its appearance is widely differ-



Heath sculp.

ARGONAUT or PAPER NAUTILUS
in different views

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ent from the rest, and exactly similar in all respects to the genus *Sepia* or Cuttle, except in having expansile membranes at the two foremost arms, a suspicion has often been entertained, that it could not be the true or proper inhabitant of the shell, but that it was some species of Cuttle, which was a usurper of the shell in which it swam; and this suspicion was strengthened by the consideration that many of the Univalve shells are occasionally inhabited or usurped by some of the smaller species of the Crab-tribe, as the *Cancer Bernardus*, *Diogenes*, and others.

As the animal of the Paper-Nautilus is extremely quick-sighted, and descends from the surface on the least appearance of danger, it is very difficultly obtained, and is principally found after a storm, during which it is sometimes driven ashore.

Most of the European naturalists seem, till lately, to have coincided in opinion that the animal was not the real and proper inhabitant of the shell, notwithstanding the testimony of the celebrated Dutch observer, Rumphius, who, above a century ago, during his residence in the island of Amboyna, had opportunities of examining the

animal, and who has even described and figured it with sufficient exactness to prove that it was not a mere *Sepia* or Cuttle, but that it was really furnished with the palmated arms which operated as sails, and occasionally as oars in swimming. Rumphius's observations were however, in a great degree, unknown to the generality of writers, by being inserted in a work entitled *Ephemerides Naturæ Curiosorum*.

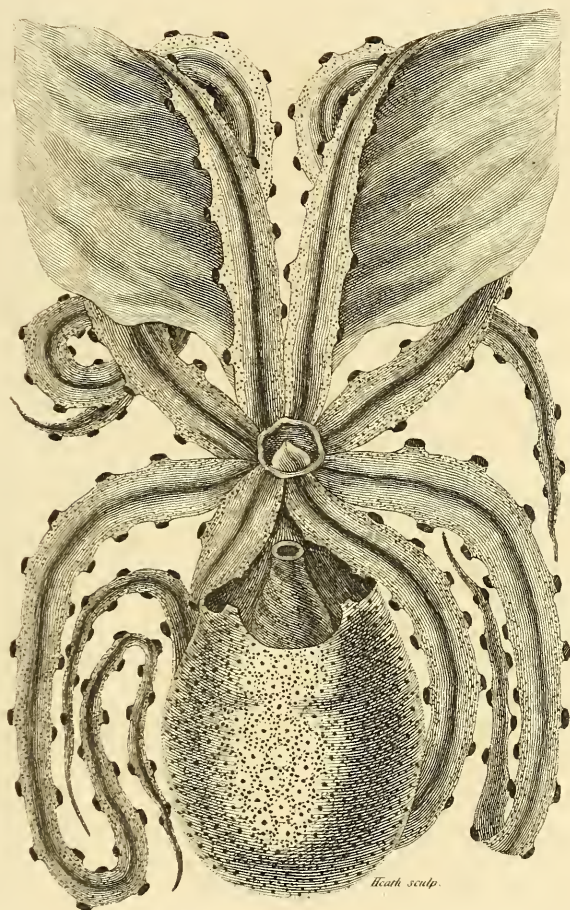
In the British Museum is a specimen of this dried and expanded upon paper, accompanied by a model in wax, seated in the natural shell. From an inspection of the dried specimen alone all doubts must vanish as to the real existence of the animal, and it was from this specimen, assisted by the model, that the figure which I myself caused to be published of the Paper-*Nautilus* in the act of sailing was executed.

This figure of the animal seated in the shell is the first that has been given since the days of Rumphius. Being particularly solicitous on this subject, I requested the late Professor Sibthorpe of Oxford, to attend, during his travels, to the history of this animal, and to endeavour by every possible method to obtain a specimen, in order to remove

any uncertainty that might still remain. By good fortune he succeeded in the attempt, and brought back a middle-sized specimen of the shell with the animal in it. This I examined, and had the further satisfaction to find that it exactly coincided with all that had been said by those who believed it to be the real inhabitant-animal of the shell. The two membranes were still wider in proportion than in any figure yet represented; and on each side the body was a very numerous groupe of small eggs. These I examined in order to find whether the embryo-animal with its shelly covering existed in the egg, which would at once have been an experimentum crucis on the subject; but the eggs were not sufficiently advanced to shew this particular. Since that time however specimens of the animal in its shell have been brought to the French National Museum, and on an examination of the eggs in these specimens, it appears that the embryo-animal is furnished, like snails and other shell animals, with the shell, even while yet in the egg; so that no farther doubt now remains of the Cuttle-shaped animal inhabiting the Paper Nautilus being the true and natural inmate of the shell. I have been the more particular on this subject, since

some of the latest writers, and even Lamark and Cuvier, were doubtful; or rather, gave into the notion of the shell being inhabited by an animal which was not its constructor.

It now remains to describe, as shortly as possible, the animal itself; and this will be best done by saying, that the species of *Sepia* or Cuttle-Fish which it most resembles is the Common Eight-Armed Cuttle-Fish, or *Sepia Octopodia* of Linnaeus: the body is oval; the head furnished with a parrot-shaped beak, like that animal; and the arms, which are eight in number, are of nearly equal length, each beset on its upper surface with two rows of suckers or fasteners as in the Cuttle-Fish, and each of the first or front arms is dilated on its inner side into a very large oval, semitransparent process or web, which the animal holding in such a manner as to unite at the edges, they form a large sail-like concavity, which catching the gale, enables it at pleasure to navigate the surface of the sea when calm. The spectacle, as before observed, has been described by various authors, but by none more elegantly than by Pliny, whose short and beautiful description has been generally quoted by modern writers.



ANIMAL
of the granulated or tuberculated Paper Nautilus

1808 Oct. 1 London Published by G. Hearsley Fleet Street.

“ Among the principal miracles of Nature (says he) is the animal called Nautilus or Pompilos. It ascends to the surface of the sea in a supine posture, and gradually raising itself up, forces out, by means of its tube, all the water from the shell, in order that it may swim the more readily; then throwing back the two foremost arms, it displays between them a membrane of wonderful tenuity, which acts as a sail, while with the remaining arms it rows itself along; the tail in the middle acting as a helm to direct its course: and thus it pursues its voyage; and if alarmed by any appearance of danger, takes in the water and descends.”

The Paper Nautilus is an inhabitant of the Mediterranean and Atlantic seas. In the Indian seas is found a species so similar that it has generally been considered as a variety: it differs in having the shell marked into numerous slight tubercles on each side the furrows. This is the variety described by Rumphius, in his account of its inhabiting animal, observed by him during his residence at Amboyna. There are other species and varieties of this genus, which the short limits of our lectures will not permit us to particularize. I shall only observe that the supposed species, so much celebrated under the title of the glass Nau-

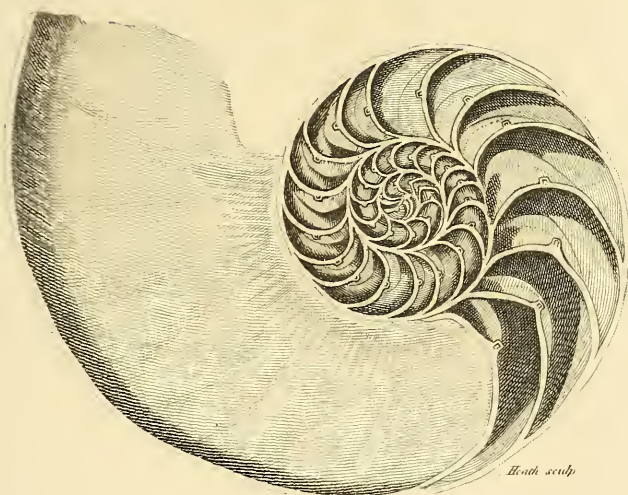
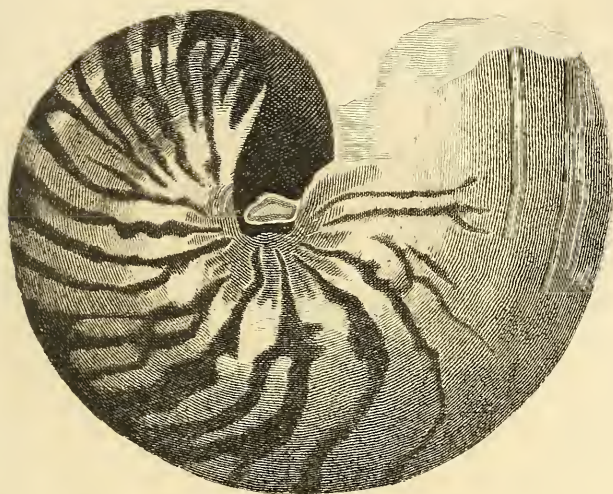
tilus, and which is the *Argonauta vitreus* of Linnæus, (so very rare that hardly more than four or five specimens are to be found in the European cabinets) is suspected by an ingenious French Naturalist to be rather the internal shelly support or bone of some kind of unknown Molluscou animal, than a real and proper shell. Yet, on the other hand, we are assured that Monsieur Bonnet has actually seen the shell sailing like other species of this genus, to which its inhabiting animal is greatly allied.

I shall now proceed to the next Linnæan set or genus of shells, which is almost equally extraordinary with that of *Argonauta*, and has been often confounded with it by careless readers of works on Natural History. This is owing to an unfortunate similarity of names; for both have been called by the general title of *Nautilus*. Linnæus, in order to prevent confusion, named the former genus *Argonauta*, and restricted the generic name *Nautilus* to that which we are now going to consider, and which is in common language called the *Pearly Nautilus*, in order to distinguish it from the Paper *Nautilus* or *Argonauta*. The principal species of the Linnæan genus *Nautilus* is the *N. Pompilius*, a large and strong shell,

NAUTILUS POMPILIUS

or Pearly Nautilus

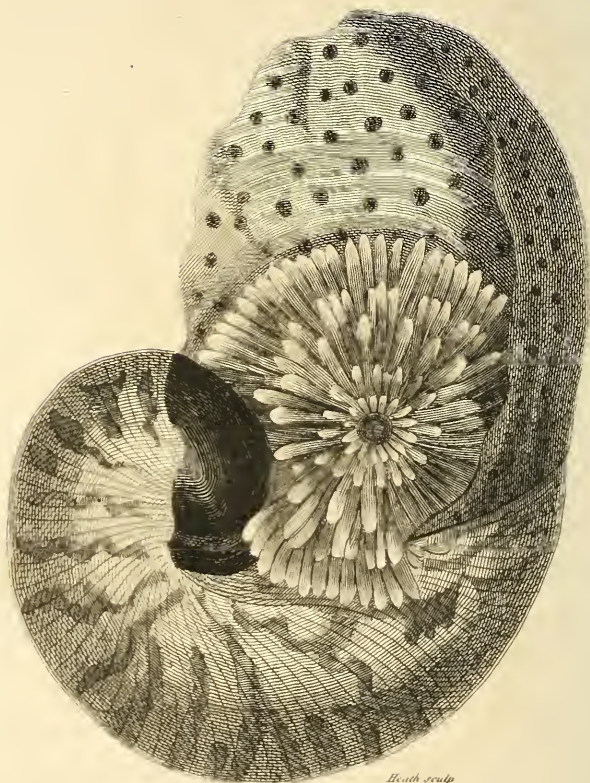
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*Longitudinal Section of the Shell
to shew the internal structure*

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PEARLY NAUTILUS
*with the Animal seated in it and
expanding its hood or sail.*



Heath sculp

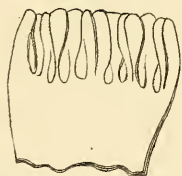
often measuring five or six inches in length: it is of a very firm or dense fabric, of a smooth, rounded outline, and of a shape somewhat compressed on the sides, with a very wide opening or mouth, and with the back-part rolled into a spiral form within the cavity of the shell. The colour, externally, is a dull yellowish-white, marked with numerous zebra-like yellowish-brown or dusky bands, and within of the richest and brightest silvery-pearl-colour. When the natural pellicle or epidermis of the outside is rubbed off, the whole shell appears silvery also. The great and striking character of the genus however, at least so far as regards the shell, is the extraordinary structure of the internal part, which is formed into a great number, (from thirty to forty) separate chambers or divisions, each communicating with the rest by a small tubular hole near the centre. The opening or mouth of the shell therefore presents a large but shallow concavity, pierced with a central or nearly central hole, and beyond lie all the divisions before-mentioned. The body or chief part of the inhabiting animal fills up the front or great concavity, and that only; while from its extremity proceeds a slender tail or process, passing through all the rest of the chambers; and it has

been supposed by some, that the animal possesses the power of at pleasure filling up the chambers or cavities either with air or water, or of exhausting them of both occasionally, in order to make itself specifically heavier or lighter, during its navigations; for this animal is also supposed to have a power of sailing, though in a less perfect manner than the Argonaut or Paper Nautilus. The animal is also indistinctly allied to the Cuttle-Fish tribe; having an oval body, with the front or central part furnished with a parrot-shaped beak, and surrounded by arms or tentacula; but they differ from those of the Sepiæ or Cuttles in being very short, extremely numerous, disposed in several concentric rows or circles, and not beset with any visible suckers. From above the neck or round the upper part of the head rises a large, concave flap or hood, beset on the inside with numerous but small suckers or concave tubercles. By the elevation and expansion of this concave flap or hood the animal of the Pearly Nautilus is supposed to sail. It is of a pale reddish-purple colour, with deeper spots and variegations.

It is remarkable that this animal has also been described and figured in the works of Rumphius, but the drawing representing it in its recent and

ANIMAL
of the Pearly Nautilus taken out of its Shell

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Outline of one of the Arms

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natural state was unfortunately lost, and the figure accompanying the description of that author was executed from a specimen long preserved in spirits, and which had totally lost its natural appearance. It therefore, of course, gives no distinct idea of what it was meant to elucidate. From the time of Rumphius the animal seems to have remained in great obscurity, till it was lately again described with accuracy by a French writer, and a figure, said to be faithful, accompanies the description, and may be found in the voluminous continuation of Buffon's Natural History by Sonnini and others.

The animals of most of the remaining Linnæan genera of the Univalve Shells are more or less allied in shape to the common Snail, which is itself allied in a similar manner to the naked or shell-less animals called Slugs, belonging to the genus *Limax* among the naked Mollusca.

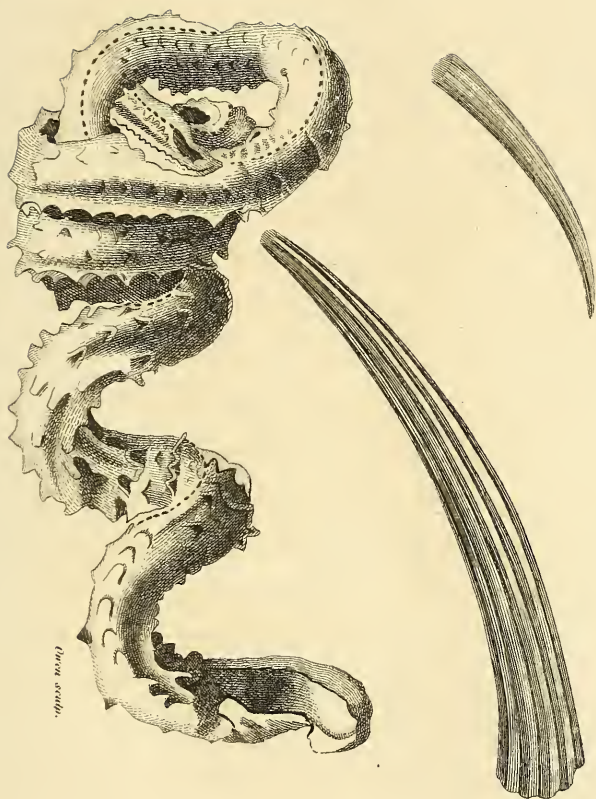
Instead of taking up the time appointed for this lecture with a mere enumeration of the Linnæan genera of Shells, I shall content myself with observing that they are admirably constituted on the principles of true science, and are to be regarded as a very high improvement on all former plans of arrangement; but that they are to be

considered rather as forming a general outline than a minute and strictly accurate illustration of the subject.

Among those genera whose inhabiting animal differs from the rest as to its nature, the genus *Dentalium* is an example: the shell is shaped like an Elephant's tusk in miniature, and its inhabiting animal is supposed to be allied to a *Terebella*. The genus *Serpula* is of various shape in the different species, but is generally of an irregularly twisted appearance, resembling a long tube warped in different directions. Its inhabitant is also supposed to resemble a *Terebella*.

The genus *Teredo* is in reality a kind of naked worm, which lines with a shelly matter the winding or irregular cavities which it forms in wood or other substances: its head is armed with a pair of very strong calcarious or shelly jaws, with which it works its way into the substance it inhabits, which is generally the wood of the bottoms of ships. This is the celebrated and destructive animal called the Ship-Worm, the *Teredo navalis* of Linnæus, so formidable for its ravages, and which hardly any contrivances yet suggested by human ingenuity have been found fully sufficient to prevent. Thus a contemptible worm, multiply-

DENTALIUM ELEPHANTINUM.



SERPULA MURICATA



ing beyond its usual limits, is capable of destroying the most boasted efforts of human industry. About the year 1730 the most flourishing republic in Europe was made to tremble at the name of this seemingly insignificant creature; the Dykes of Holland during that year exhibiting such marks of decay in many parts, where they had been attacked by these animals; originally introduced by ships from the East Indies, that great apprehensions were entertained of the Dykes giving way, and exposing the country to the ravages of the ocean.

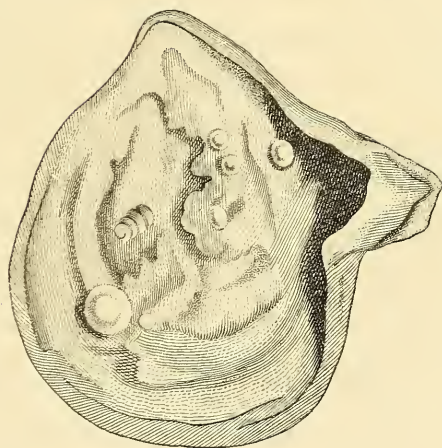
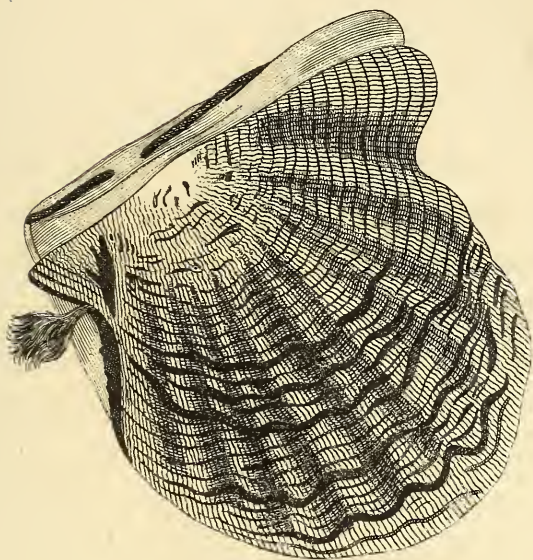
The last Linnæan genus of the Univalves, the *Sabella*, is improperly placed among the shelly tribe; since the tubular structure, by Linnæus called the shell, is merely composed of agglutinated grains of sand, lined by a connecting membrane. The inhabiting animal is allied to the genus *Nereis* among the naked Mollusca.

Proceeding to the Bivalve Shells, we shall observe that the chief instances in which the inhabiting animal differs in character from the rest, are those of the genera entitled *Anomia* and *Pinna*. Of these the genus *Anomia* is inhabited by an animal whose nature is not yet fully ascertained; and

the genus *Pinna* by an animal allied to the Snail and Slug; whereas in the rest of the Bivalves, the inhabitant is more or less allied in shape to an Oyster or a Muscle.

Of the Linnæan genera of Bivalve Shells, one of the most important is that of *Mytilus*, since it contains the valuable species called the *Mother-of-Pearl Shell*; which is the *Mytilus Margaritiferus* of Linnæus. This shell, which grows to a very considerable size, is of a flattened and rounded shape, with the back or hinge-part strait. Its colour on the outside is brown, variously spotted and clouded according to circumstances, and on the inside, as every one knows, of the most brilliant, iridescent, silvery lustre. It is a shell of very considerable thickness, and when properly cut and polished is the beautiful substance usually known by the name of Mother of pearl, and of which so many ornamental articles are formed; and from the cartilaginous or tendinous hinge at the back-part of the shell, in a petrified state, is produced that very rare and beautiful extraneous fossil called the *Androdamas*, (the *Helmintholithus Androdamas* of Linnæus,) which when cut and polished, in the disposition of its fibres, and in its colours, bears

MYTILUS MARGARITIFERTUS

or Pearl Muscle*Inside View*

some resemblance to the eye of a peacock's feather. But the far more valuable products of this shell are Pearls themselves, which are found sometimes loose, and sometimes adhering to the shell, as well as in the body of the animal.

The *pearl muscle*, or *Mytilus margaritiferus*, is most common about the shores of the East-Indian islands, and particularly of Ceylon, where the chief pearl-fisheries have long been established, and of which an interesting description may be found in the Asiatic Researches and other publications. According to the tenor of these accounts, one of the chief pearl-fisheries of Ceylon is carried on, at different periods, in a semilunar bay called the bay of Condatchy, surrounded by a waste, sandy district: during the fishing-season this bay is said to offer a scene equally novel and astonishing; being frequented by a heterogeneous mixture of thousands of people of different nations, casts, and colours, residing in tents and huts erected on the surrounding shores: you here meet with brokers, jewellers, and merchants of all descriptions, as well as dealers in all kinds of provision; but by far the greater number are engaged in the pearl-business itself; in drilling, sorting, and otherwise preparing

them for sale. The drawbacks against this scene of entertaining confusion are, the offensive atmosphere occasioned by the putrefaction of the innumerable pearl-muscles lying in heaps on the shores; the badness of the water round the spot, which is so brackish as scarcely to be drinkable; the extreme heat of the weather during the day, and the coldness and heavy dews of the night. The pearl-fishery therefore of Ceylon is extremely injurious to the health of those who engage in it, and frequent it. The Ceylonese pearl-divers are said to make use of no particular precautions in exercising their occupation, but descend to the bottom at the depth of from five to ten fathoms by means of a large stone, fastened to them with a rope, and being furnished with a basket, they collect, with as much expedition as possible, such shells as happen to lie about the spot of their descent, continuing their search about two minutes, when, according to a signal which they make to the boat to which their cord is attached, they again ascend with their treasure. It is added that each Diver will, in general, bring up as many as one hundred pearl-shells of various sizes in his net; and that, from long habit, some of these

Indian divers become so expert as to be able to continue under water for the space of six or seven minutes.

This reminds us of the famous Sicilian diver mentioned by Kircher and others, who could remain so long under water, that he obtained the popular title of Fish. Frederic, King of Sicily, unthinkingly tempted him by the offer of a golden cup thrown into the sea, to dive near the gulph of Charybdis : he made two attempts, and each time astonished the spectators by the time he remained under water ; but in the third attempt he was, as is supposed, caught in the eddy of the whirlpool, and never again appeared. An ingenious French naturalist, whom I before have had occasion to mention, is of opinion that he was caught by a Colossal Cuttle-Fish!!! The accounts however of the Sicilian writers are against this supposition, since they affirm that his body was thrown up on the coast, at above thirty miles distance from the spot where he descended. With respect to the animal inhabiting the pearl-shell, it is (we know) popularly called the pearl-oyster ; but in reality belongs to the Linnæan genus *Mytilus*.

It is furnished with a lengthened tubular tongue or soft trunk, by the assistance of which it deposits a small drop of a glutinous fluid on whatever place or substance it wishes to attach itself to, and then, suddenly withdrawing the trunk, forms, in consequence, a thread or ligament; and repeating this operation a great many times, fastens itself by a short silken tuft. In the soft or pulpy part of the body of the animal are found the pearls; the real nature and production of which, as to the œconomy of the animal, is perhaps still in a great degree unknown. The idea of Reaumur is not improbable: viz. that the pearls are formed like the concretions called bezoars in quadrupeds and some other animals. It is said that between one and two hundred pearls have been sometimes found within a single pearl-muscle. Though the general colour of the shell and the pearl is silvery, yet some have been found of a deep red, and others of a pink colour. It is farther observable, that a pearl, when cut through, frequently exhibits some extraneous body, as a grain of gravel or other substance in the centre, round which the several lamellæ or concentric con-

cretions have been formed *. Besides those found in the body of the animal, several are often observed rising from the internal surface of the shell, to which they are closely attached, so as not to be completely round, and are therefore considered as of little value. The largest Pearl-Shells, and such as are most encrusted with extraneous marine substances, as *Serpulæ*, Corals, &c. are in general observed to be most productive of pearls; while the smaller and smoother shells afford but few, or so small as to be of no importance in commerce.

In addition to what has been said relative to Pearls, we may add, that irregular or grape-shaped pearls sometimes occur, which seem to be owing to a coalescence of several smaller ones into one mass. One of the noblest pearls on record is that which Cleopatra is absurdly said to have dissolved in vinegar, during an entertainment which she gave to Mark Antony, and afterwards to have drank it. We must surely suppose that she caused it to be well bruised first, before she put it into the vinegar. It was a pearl belonging to a

* According to Cuvier pearls may be considered as formed by an extravasation of the calcarious matter with which the animal is furnished, for the augmentation of its shell.

pair of her ear-rings: the fellow to it is said to have been sent to Rome, and after being properly cut in two, formed a pair of pendants for the ears of a celebrated statue of Venus in that city. It may not be improper to observe, that the elegant manufacture of what are called false or artificial pearls, which sometimes so nearly equal true ones in beauty as to be very difficultly distinguished from them, is originally a French invention, and is still carried on in its greatest perfection at Paris. The thin glass bubbles used for this purpose have their inside lined by a pearl-coloured substance thrown into them through a small tube; the pearl-coloured substance is prepared by well beating the silvery scales of fishes, and particularly of bleaks, in water, which being poured away, the silvery sediment undergoes several other ablutions, and being then mixed with proper agglutinating ingredients, is used in the manner just described. The inventor is said to have been a Bead-maker of the name of Jacquin, and to have lived about the time of Henry the Fourth. This man observed, that on washing the scales of the Bleak, a most beautiful silver-coloured powder was obtained; and it occurred to him that by intro-

ducing this substance into the inside of finely-blown glass beads, slightly tinged with opaline hues, a perfect imitation of real pearls might be made: (for an attempt of a similar nature had some years before been made in Italy, by filling glass bubbles with quicksilver; but which was immediately discouraged; first, on account of the pearls so prepared wanting the true colour, and because they were judged to be dangerous by the physicians.) Jacquin was at first put to great difficulty in preserving the silver-coloured powder, which, if not used quickly, becomes putrid, and diffuses an intolerable smell. Attempts were made to preserve it in spirits, but by this method the lustre was entirely destroyed. It was at length found, that volatile alkali possessed the power of preserving the substance without injury to its colour. Many years elapsed before the false pearls became very common; and even so late as the reign of Louis the Fourteenth it is said that a French Marquis who possessed very little property, but who was violently in love with a particular lady, gained her affections by presenting her with a rich string of these pearls, which cost him but three Louis's, but which the Lady, supposing them to

be real ones, valued at a very high sum. The servant, who put the Marquis upon this stratagem, had previously assured his master that these pearls withstood heat and moisture; that they were not easily scratched, and that their weight was the same with that of real pearls. This anecdote, which is detailed by Professor Beckman, proves that artificial pearls did not become common, even in France, till many years after their first invention.

The trade of artificial pearl-making is still carried on at Paris by the descendants of Jacquin the original inventor, but they are also made in many other parts of Europe, and with several variations as to the colour and kind of the glass, and other minute particulars.

The *Mytilus margaritiferus* of Linnæus, or great Pearl Muscle, is not the only shell which produces pearls. A species of the genus called *Mya*, and which is the *Mya margaritifera* of Linnæus, also produces pearls, though, in general, of a far smaller size, and of inferior quality. This shell is commonly called the European pearl Muscle, and much resembles the common river muscle, though of a different genus. It is

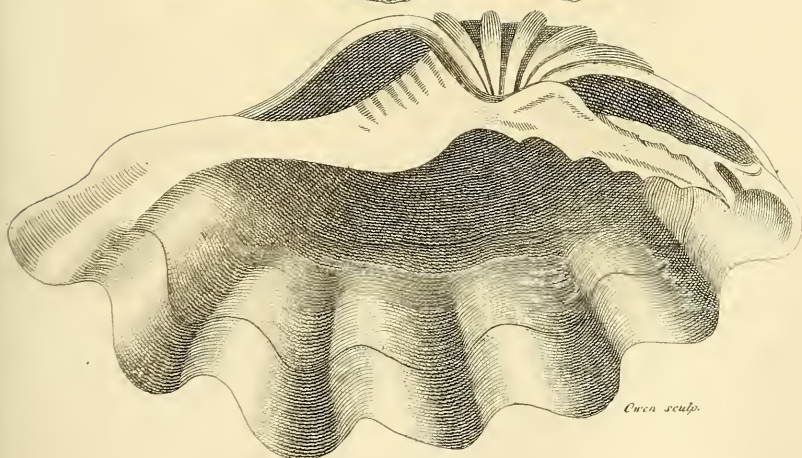
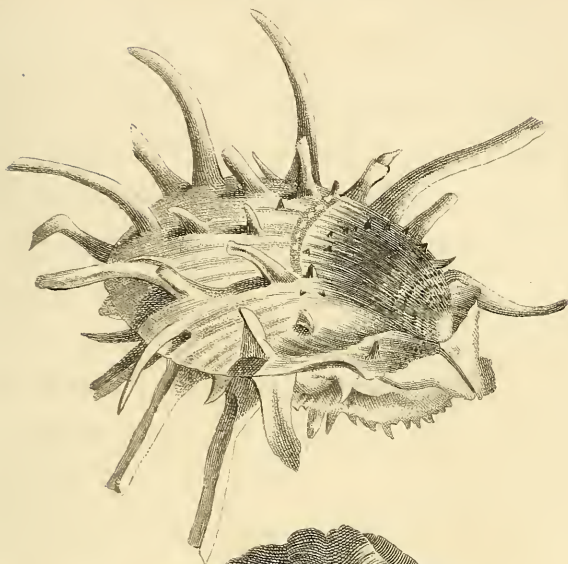
found in rivers in the north of England, in Scotland, Ireland, and many other parts of Europe. In the seventeenth century several rich pearls of large size are said to have been obtained from this shell in some of the rivers of Ireland. One was valued at upwards of £.4, another at £.10, and a third at no less than £.40. As a species, the European pearl-muscle, or more properly *Mya*, is distinguished by having a thick, coarse, blackish shell, generally barked or decorticated towards the hinge *.

I have before mentioned, when speaking of the real or Indian Pearl-Shell, the French art of making artificial pearls. There exists also an art, said to be often practised by the Chinese, and which Linnæus attempted to put in practice in Europe, of forcing, as it were, the production of pearls, in the *Mya margaritifera* or European pearl Muscle, by piercing the outside of the shell in several places, so as barely not to make complete perfo-

* Pearly concretions are also occasionally formed in all shells, and are of different colours according to that of the shell in which they are formed. Thus, the animal of the large univalve shell called the *Strombus gigas* or great rose-mouthed Strombus sometimes produces pearly concretions of a fine rose-colour.

rations. In this case, the animal, conscious of the weakness or deficiency of the shell in those spots, soon begins to secure the weakened parts by depositing over them a great quantity of its pearly calcarious matter, and thus forms so many pearly tubercles over them. The practice however is, I believe, considered as not of importance sufficient to make it an object of gain, but rather of mere curiosity; the pearly tubercles thus obtained being of inferior beauty to those more naturally produced.

The Linnæan genera of Bivalve Shells are somewhat less numerous than the Univalves, and are principally constituted from the different structure of the teeth or prominences belonging to the hinge of the Shells. Among the most remarkable genera are those of *Spondylus* and *Chama*; in the former of these, the chief species, which resemble Oysters in shape, are of rich colours, and beset with numerous and differently shaped spines and processes, giving the whole shell a singularly curious aspect. In the genus *Chama*, many species of which greatly resemble those of *Spondylus*, we have an example of by far the largest and heaviest of the whole testaceous tribe; the *Chama Gigas*



Owen sculp.

Chama Gigas or Great Clamp Shell

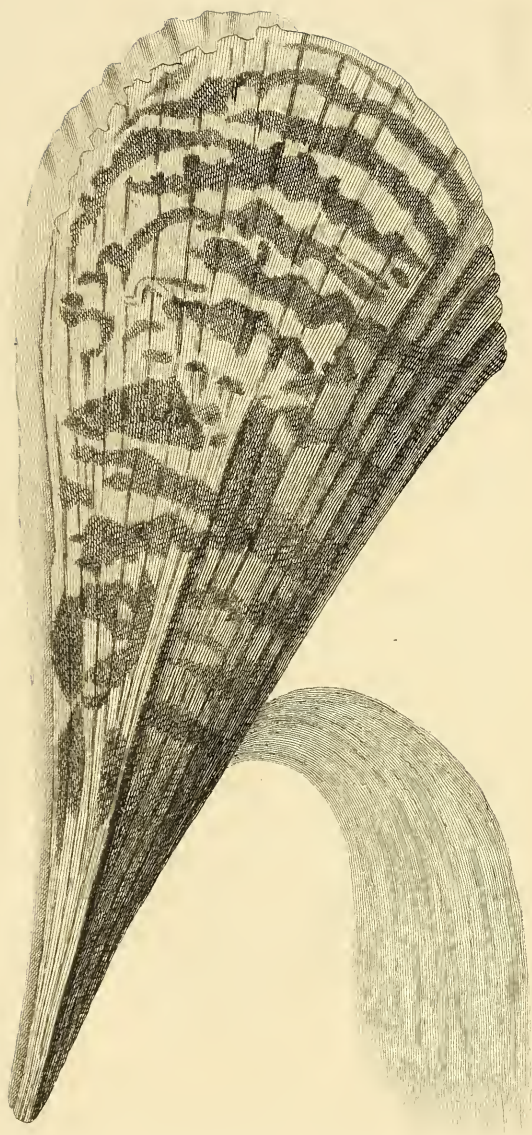
or Great Clamp Shell, as it is called, sometimes measuring more than three feet in length, and weighing upwards of five hundred pounds. The inhabiting animal very much resembles an oyster in appearance, and is said to furnish food sufficient for one hundred persons. Specimens of this gigantic shell in its full grown state are not very common in collections, on account of their inconvenient size; those being preferred which are in their small or young state; but in very large collections, as in the British and Leverian Museums, they may be seen to great advantage; particularly in the latter, where there is a single valve of this shell weighing, I believe, at least three hundred pounds.

The concluding genus of the Linnæan Bivalve Shells is the *Pinna*, the animal of which is considered by Linnæus as allied to a *Limax* or Slug, and consequently to the Snail tribe also. Some of the species and varieties of *Pinna* are very large shells, of a thin structure in proportion to their size: and they are generally affixed to rocks or other objects by a large tuft of very fine but strong silken fibres or threads, which the animal has the power of forming, by thrusting out a kind

of pointed trunk, with which it touches the object it wishes to adhere to, and by retracting it, forms a glutinous thread; and, by the repetition of this motion, forms the whole tuft by which it is fastened.

The large sea *Pinna* or *Pinna rudis* is a curious instance of this. This shell is brown externally, with a slightly iridescent silvery cast within; of a lengthened shape, with a very narrow base, and dilated and rounded towards the extremity. It is a frequent inhabitant of the European coasts, and in some places, as, about the coasts of Sicily and Italy, the silken tufts are often collected, and spun into various articles of dress, as gloves in particular; the silk requiring no dye, but retaining its native colour, which is an elegant, glossy, yellowish brown. Specimens of this kind of silk are generally to be seen in most of our Museums. Neither is this faculty of fastening or anchoring by means of silken fibres confined to the genus *Pinna*, but takes place, as we have already seen, in the genus *Mytilus*, and probably in some of the rest.

I now proceed to the *Multivalve Shells*, so named, as consisting of several valves or pieces.



Owen sculp.

PINNA RUDIS *var.* ROTUNDATA
or Great-Sea Pinna

CHELTON SQUAMOSUS



*Under View, shewing the Animal, with a view
of one of the branchia & scales magnified*

The Multivalves are distributed by Linnæus into three genera, one of which, named *Pholas*, has the general appearance of a bivalve; but on close inspection, will be found to differ; having small or accessorial valves or pièces at the back part of the shell. The inhabiting animal resembles an Ascidia. The most common species of *Pholas* is the *Pholas Dactylus* of Linnæus, a native of the European seas: this species has the faculty of piercing and imbedding itself in calcareous rocks, in which it is generally found: the animal is considered as an edible shell-fish, and in some places is regarded as a delicacy.

The next genus is of a very singular appearance, and is called *Chiton*. It is of an oval shape, and is composed of several transverse pièces; those at each extremity having a rounded outline. The inhabiting animal is shaped like a *Doris* or Sea-Snail. The species of *Chiton* are pretty numerous, and there is a considerable degree of general similarity between them. One of the largest is the *Chiton squamosus*, measuring about three inches in length, and of a greenish white colour. It is a native of the American seas; but several of this genus are found also about the European coasts.

The remaining genus of *Multivalve* shells is of a more singular nature than any of the rest : it is called *Lepas* or Barnacle : the shell consists of several unequal valves or pieces, and is affixed at the base, in some species, to a long, wrinkled, leather-like tube ; and in others immediately to the substance to which it is attached, without the intervention of the leathery tube. The inhabiting animal is of a very singular structure, and is a kind of *Triton*, perfectly resembling the Linnæan genus *Triton* among the naked *Mollusca* : the body is oval, of a soft consistence, furnished with a long tubular trunk, surrounded by several pair of long, curved, jointed arms or tentacula, which taken all together have a kind of feather-shaped aspect.

Among those species of *Lepas* in which the shell is seated on a tubular process, one of the most common is the *Lepas anatifera*, or Barnacle Shell. It is frequently found adhering to the bottoms of ships, to rocks, and other marine substances, whether fixed or floating, and is sometimes seen single, and sometimes in groupes : the leathery tube is from one to two inches in length, and the shell itself somewhat more than an inch long : its colour is white, slightly clouded with blueish brown, and



LEPAS ANATIFERA
*or Barnacle Shell, at the base of which
 are seen some other species of the same genus*

often with a cast of flesh-colour ; and is composed of about five valves ; the two on each side being largest, and the fifth or back valve being slender or narrow. From the front of the shell hang out the curved tentacula, of a somewhat dusky colour, and resembling the shape of a plume of feathers. Among the numerous errors with which Natural History was formerly encumbered, there prevailed an idea that the Bird called the Barnacle goose was not produced like other birds, from an egg, but that it derived its origin from this shell. This error, gross and absurd as it was, seems to have met with credit from authors who should have viewed objects of this nature with other eyes than those of the vulgar. It was supposed by these philosophers that the inhabitant of this shell was an immature bird, or young of the above-mentioned goose, which, after having attained its plumage, liberated itself from the confinement of its shell, and dropped into the water. The numerous tentacula or arms of the inhabiting animal, which are disposed in a semicircular form, and, as before observed, have a feathery appearance, seem to have been all that could reasonably be alleged in favour of this strange supposition. Among others who have

mentioned this goose-bearing shell is Gerard, the author of the well-known Herbal. His account runs as follows. "But what our eyes have seen, and hands have touched, we shall declare. There is a small island in Lancashire called the pile of Fowlders, wherein are found the broken pieces of old and bruised ships, some whereof have been cast thither by shipwracke, and also of the trunks and bodies, with the branches of old rotten trees cast there likewise; whereon is found a certain spume or froth that in time breedeth unto certaine shells in shape like those of a muskle, but sharper pointed, and of a whitish colour; wherein is contained a thing in form like a lace of silk, finely woven, as it were, together, of a whitish colour, one end whereof is fastened unto the inside of the shell, even as the fish of oysters and muscles are: the other end is made faste unto the belly of a rude masse or lumpe, which in time commeth unto the shape and forme of a bird. When it is perfectly formed, the shell gapeth open, and the first thing that appeareth is the foresaid lace or string: next come the legs of the bird hanging out, and as it groweth greater, it openeth the shell by degrees, till at length it is all come forth, and hangeth only

by the bill; in a short time after, it commeth to full maturitie, and falleth into the sea, where it gathereth feathers, and groweth to fowle bigger than a mallard, and less than a goose, having black legges and bill or beake, and feathers black and white, spotted in such a manner as is our Magpie, called in some places a Pie-Annat, which the people of Lancashire call by no other name than a tree-goose; which place and all those parts adjoining do so much abound with, that one of the best is to be bought for threepence. For the truth hereof if any do doubt, may it please them to repaire unto me, and I will satisfy them by the testimony of good witnesses."

The species of *Lepas* furnished with the coriaceous tube are pretty numerous, several new ones having been of late years discovered: these animals sometimes attach themselves to animated as well as to inanimate bodies, and are frequently seen on turtles and other marine animals. In the Museum of the late Mr. Hunter is an instance of a species of Sea-Snake, the *Anguis platyura* of Linnaeus (*Hydrus bicolor*) of more modern naturalists, which has a groupe of small *Lepades* affixed to one side of its tail.

Among the species of *Lepas* without the coriaceous tube or stem, or such as are immediately affixed by the base of the shell, one of the most common is the *Lepas Balanus* of Linnæus, or common Acorn-Shell; frequently seen about almost all the European coasts, on rocks, &c. and a smaller species, extremely resembling it, is often seen grouped on the backs of Oyster-shells. The animals of the whale tribe are often infested by various kinds of *Lepades*, some of which are merely affixed to the surface, while others are deeply imbedded, to the distance of some inches beneath the cuticle.

Having thus given a general description of the testaceous tribe, we have to observe, that the shell-animals are produced from eggs, which in some species are gelatinous, and in others covered with a calcareous shell; and that the young animal emerges from the egg with its shell on its back: the most familiar and convincing proof of this may be obtained by observing the evolution or hatching of the eggs of the common Garden Snail, as well as of several of the water-snails, which deposit eggs so transparent that the motions of the young, with the shell on its back, may be very dis-

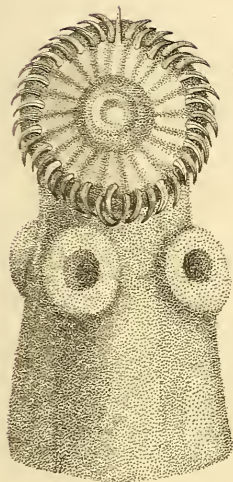
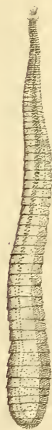
tinctly seen several days before the period of hatching. All the shell-animals are of such a constitution as perpetually to secrete or exsude from their bodies a viscid moisture, and it is with this, managed according to the exigences of the animal, that the shell is throughout life increased in dimensions, and repaired when accidentally broken in any particular part. The growth of shells proceeds from the edges of the mouth or opening, and thus the spires or turns of the Univalve shells are gradually increased in number and size, till the animal has arrived at the full limits of its growth. The Bivalves are increased in a similar manner, by the gradual enlargement of the outline of each valve.

LECTURE XII.

THERE exists a large tribe of animals to which we have as yet paid no attention. These animals are, in common language, termed Worms, and constitute a particular division of the Order *Vermes* in the Linnæan arrangement. Their forms are various, and their natures extraordinary. The major part of them are the inhabitants of living animal bodies; their introduction into which is one of those inscrutable mysteries which perhaps must for ever evade the power of human intellect. It is sufficient, at present, to say, that they exist in most animals; some kinds in the intestines, and some in other viscera. I do not mean however to pursue their history any further than is merely necessary, in order to elucidate the various divisions of the Animal World.

Of the whole tribe of Vermes none is more curious than the genus called *Tænia*, which is extremely numerous, and presents a great diversity of appearance in the different species; some being of a globular form, with a small neck and head, while others are of immoderate length, with the body divided into very numerous joints; in some species very close set; in others more distant. The head in all the *Tæniæ*, or Tape-Worms, as they are commonly called, is of a highly curious structure; being of a rounded and slightly flattened shape, with a small orifice in the middle, and four much larger ones placed round the margin, while the whole circumference of the head is beset with a double, and, in some species, with a single row of sharp, reversed, crooked spines, by the assistance of which the animal is enabled to adhere tenaciously to the part in which it resides. It is surprising that Linnæus should have maintained that these animals had no distinct or proper head, and that Tyson and others, who had described them with one, were mistaken. A clear general idea of the genus *Tænia* may be obtained by inspecting a few plates of some of the principal species.

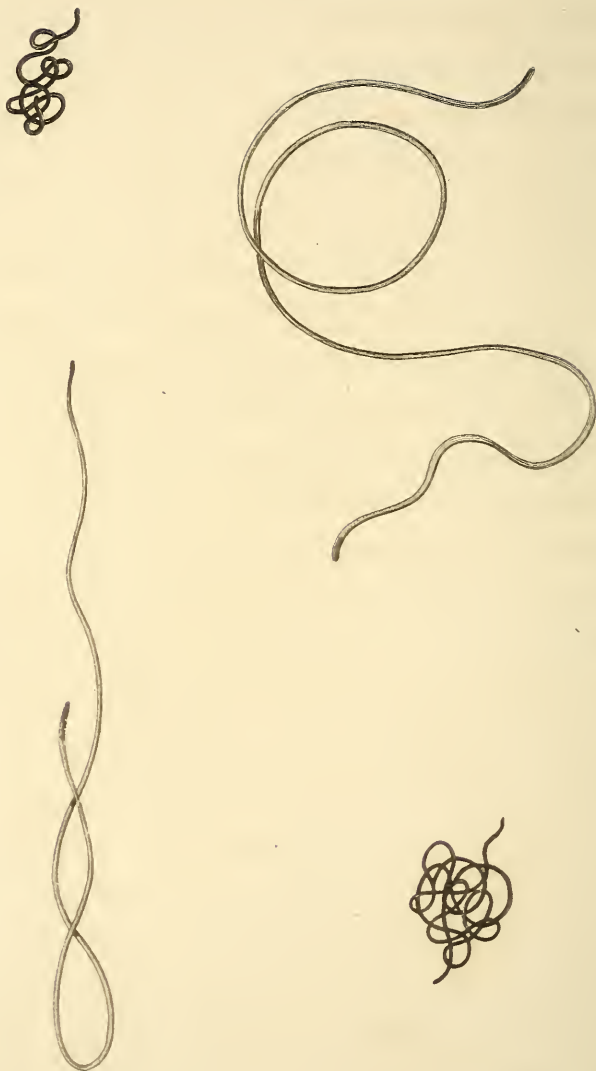
T. serrata or Serrated Tape Worm
from a cat in its natural size



Piece of the middle part of a Sheep's Tape Worm *Toxina*
measuring thirty-seven ells in length



A complete young specimen of the *Toxina* or
Sheep's Tape Worm in its natural size



Different Views of the GORDIUS AQUATICUS in its natural size

The lately instituted genus *Filaria* is so similar to that of *Gordius* or Hair-Worm, that it can hardly be separated from it with propriety. Some species of *Filaria* inhabit the waters, and some are found in the bodies of animals; even in those of insects; many kinds of Beetles and Caterpillars being infested by them. Among those which infest the waters, the most common is the Horse-Hair Worm, so called from its general appearance, usually measuring several inches in length, and being of a dusky colour, and not much thicker than a horse-hair. It is the *Gordius aquaticus* of Linnæus, and is in many places believed by the common people to be an animated horse-hair. Linnæus observes that in Sweden an idea prevails of its bite, or rather its puncture, producing the complaint called a Whitlow; and this he says was verified in the case of a Mr. Rinmann. I have likewise myself been witness to an instance of a similar nature, in which the animal, on being taken out of the water, pierced the tip of the finger, near the nail, and a whitlow was the consequence of the puncture; but whether the same complaint might not have taken place from the puncture of any other substance on the same part, I cannot take upon me to determine.

Among the most extraordinary of the Linnæan Vermes is that which he calls *Furia*. There is only one species, which is called *Furiâ infernalis*, or the Infernal Fury; and not without good reason, if we may rely on the accounts which have been given of the torments it sometimes inflicts on the person it happens to attack. Its character is, a thin, thread-shaped body, edged along each side with a row of sharp, reversed prickles, lying close to the edge of the body, or at very acute angles. It bears a resemblance therefore to a minute Scolopendra or Centipede, and from the structure of its body, is enabled to perforate the skin in an instant, so as not to be extracted without extreme difficulty. It is pretended that this worm, in the marshy parts of Sweden, and some other countries, is conveyed by some means or other through the air, and drops on the bodies of cattle and men; producing almost immediately a pain so insupportable as sometimes to prove fatal in the space of a quarter of an hour. Linnæus tells us that he himself once experienced the effects of this animal, near the city of Lund in Sweden. Dr. Sölander once gave a slight description of this worm; but, from the difficulty of obtaining recent speci-

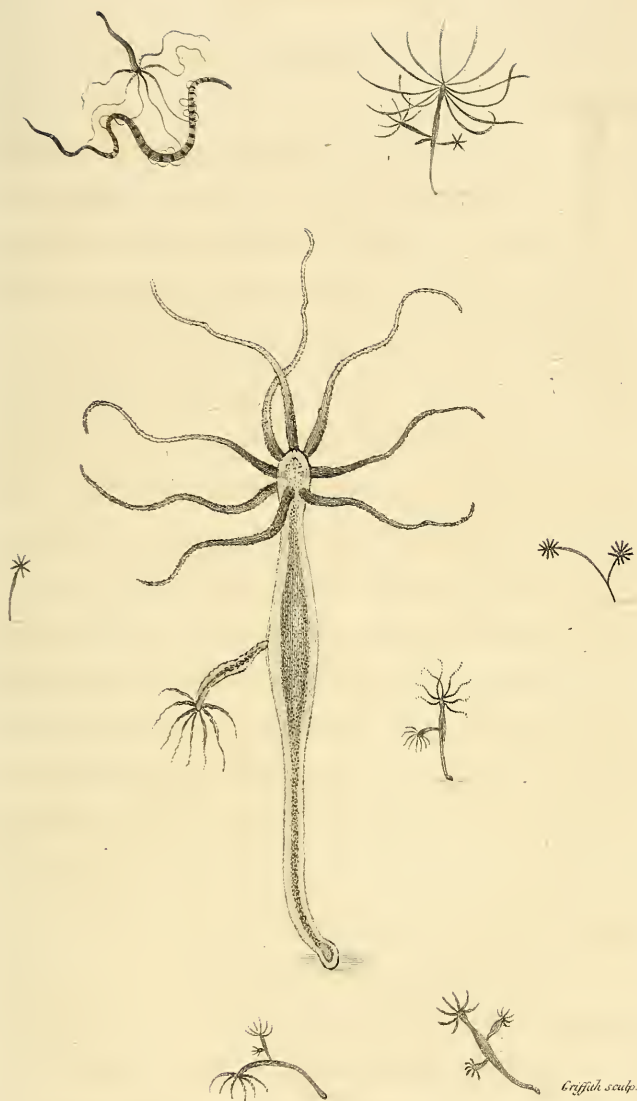
mens, its nature is still obscure; and even its very existence has been occasionally doubted; particularly by Blumenbach and Muller. There seems however to be no good reason for questioning the existence of some such animal, though the accounts of its extraordinary qualities may have been exaggerated. The best account of it is in a quarto pamphlet, published by a Dr. Hagen, as an academical thesis: in which all the observations relative to it are summed up in a concise manner, and its real existence, seemingly, well ascertained. It is said to be generally about three quarters of an inch long, and in habit or shape to resemble a Scolopendra, as I before observed.

I shall now pass to a branch of Zoology distinguished by peculiarities of organization and appearance unequalled by any other parts of the animal kingdom.

These wonderful productions are now, by the common consent of Naturalists, distinguished, in systematic arrangement, by the title of Zoophytes or Plant-Animals. Of these the genus *Hydra* or Polype deserves our first attention; not only from its wonderful nature and properties, but because it serves as a kind of standard or example of refer-

ence in many other genera of zoophytes more or less allied to it.

The genus *Hydra* or Polype, comprehending the real or fresh-water polypes, was so named by Linnæus because in reality it affords phenomena similar to those recorded of the fabulous Hydra of antiquity, which, when one head was cut off, produced others in its place. The character of the Hydra or Polype is a long, tubular body, possessing a great power of contraction and extension; affixing itself by the tail; and furnished at its upper or open end with a certain number of long arms or tentacula, differing in number in the different species. The principal species are the brown, the yellowish-grey, and the green Polypes, or the *Hydra fusca*, *grisea*, and *viridis* of Linnæus. These curious animals may be found in small streams and in stagnant waters, adhering to the stems of aquatic plants, or to the under surfaces of the leaves, and other objects. They prey on small worms, Monoculi, and many other animals which happen to occur in the same waters. If a Polype be cut in two, the superior part will produce a new tail, and the inferior part will produce a new head and arms; and this, in warm weather, in the



Different Views of the
HYDRA VIRIDIS or GREEN POLYPE
both in its natural size & magnified

course of a very few days. If cut into three pieces, the middle portion will produce both the head and tail ; and in short, Polypes may be cut in all directions, and will still reproduce the deficient organs. The natural mode of propagation in this animal, is by shoots or offsets, in the manner of a plant ; one or more branches or shoots proceeding from the parent stem, and dropping off when complete ; and it frequently happens that these young branches will produce other branches before they themselves drop off from the parent, so that a polype may be found with several of its descendants still adhering to the original stock or stem ; thus constituting a real genealogical tree : but the Polype also, during the autumnal season, deposits eggs, which evolve themselves afterwards into distinct animals, and thus it possesses two modes of multiplication. It appears a paradoxical circumstance that a Polype should be able to swallow a worm three or four times as large as itself, which is frequently observed to be the case ; but it must be considered that the body of the animal is extremely extensile ; and that it possesses the power of stretching according to the size of the substance which it swallows. It seizes its prey

with great eagerness, but swallows it slowly, in the same manner as a snake swallows any small quadruped. The arms of a Polype, when microscopically examined, are found to bear a general resemblance to those of the Sepiæ or Cuttle-Fishes, being furnished with a vast number of small organs, which seem to act as so many suckers or acetabula, by which means the animal can hold a worm, even though but slightly in contact with one of its arms; but when on the point of swallowing its prey, it then makes use of all the arms at once, in order the more readily to absorb it.

The number of Zoophytes is extremely great, and the major part are of an appearance so much resembling vegetables, that they have been generally considered as such; though the horny and stony appearance of several of the tribe, at first view declare them to be of a widely different nature from the generality of plants. In others however the softness of their substance, and their ramified manner of growth, would immediately lead any one unacquainted with their real nature to suppose them vegetables. The hard, horny, or stony Zoophytes are in general known by the name of Corals; and of these there are several ge-

nera or kinds, instituted from the structure and appearance of the Coral or hard part, and the affinity which the animal or softer part bears to some other genus among the soft-bodied Animals or Mollusca. The Zoophytes therefore unite the animal and vegetable kingdoms, and fill up the intermediate space.

By the ancients most of the Zoophytes were considered as plants; but in later times some philosophers have imagined them rather to belong to the mineral kingdom, fancying that they grew or increased somewhat in the manner of crystals and other regularly figured bodies.

About the beginning of the eighteenth century some observations were made on the common red coral, and some other species, by Count Marsigli, which seemed to prove them of a vegetable nature; for on gathering them perfectly fresh, and placing them in sea water, they appeared to put forth small flowers from all the minute cavities or hollow points on the surface. These therefore were considered as a convincing proof that coral was a plant. The arguments against this theory were, the animal odor which they diffused in burning, and a greater degree of sensibi-

lity in the supposed flowers than seemed quite consistent with the generality of plants.

A very few years after Count Marsigli's discovery and description of the supposed flowers of Coral, Dr. Peysonel, a French physician, from observations made on some parts of the European coasts, as well as on those of the West Indies, ventured to propose to the French Academy a new theory relative to the nature of Corals; in which he maintained that the supposed flowers were real animals, allied to Actiniæ, and that, in consequence, the corals should be considered as aggregates of animals, either forming, or at least inhabiting the calcarious substance of the coral in which they appeared.

To this theory no great attention was paid; and several years elapsed before a farther advance was made in the knowledge of these bodies: but at length, about the year 1730, a Mr. Trembly of Geneva, in searching after some small aquatic plants, happened to discover the animals now called Polypes: these had indeed been discovered long before by Leewenhoeck, in Holland; but he only gave a general description of the animal, and observed that it multiplied by an apparent vegeta-

tion, but was ignorant of its power of reproduction after cutting : but Mr. Trembly, surprised at the singular appearance of a creature which had at once the aspect of a plant, and the motions of an animal, determined to try the experiment of cutting it, in order to ascertain its doubtful nature ; and was beyond measure astonished to find that instead of destroying it, both parts seemed uninjured by the wound, and that in a very few days each had reproduced every limb that had been lost, and eat, and moved as before. This discovery being announced, was at first considered by many as a fable ; and it was even contended that this division of animal life was in itself absolutely impossible upon the principles of common sense as well as of sound philosophy : but at length, the attention of all Europe being excited by the singularity of the circumstance, the animals were everywhere sought after, and experiments made by cutting them in every possible direction, and their real nature thus completely ascertained ; and from subsequent observations it was found that the animals of most of the Coral tribe, both hard and soft, were strongly allied to Polypes, and were endowed with the same reproductive properties, while

others were possessed of the same power, but seemed more allied to the Actiniæ or Sea-Anemonies, and to the Medusæ or Sea-Blubbers. Afterwards the celebrated Mr. Ellis, by repeated observations made about the British coasts, proved beyond all doubt, that the smaller corals, commonly known by the name of Corallines or Sea-Mosses, were actually so many ramified Sea-Polypes, covered with a kind of strong, horny case, to defend them from the injuries to which they would otherwise be liable in the boisterous element in which they are destined to reside.

Mr. Ellis's observations on the harder or stony Corals, as well as the observations of many other philosophers, have at length proved also that these stony corals are equally of an animal nature; the whole coral continuing to grow as an animal, and to form by secretion the strong or stony part of the coral, which at once may be considered as its bone and its habitation, which it has no power of leaving, and a coral of this kind is therefore a large compound zoophyte.

I shall mention a few species both of the smaller and larger corals as illustrations of what has been said relative to their growth and structure,



SERTULARIA PINNATA

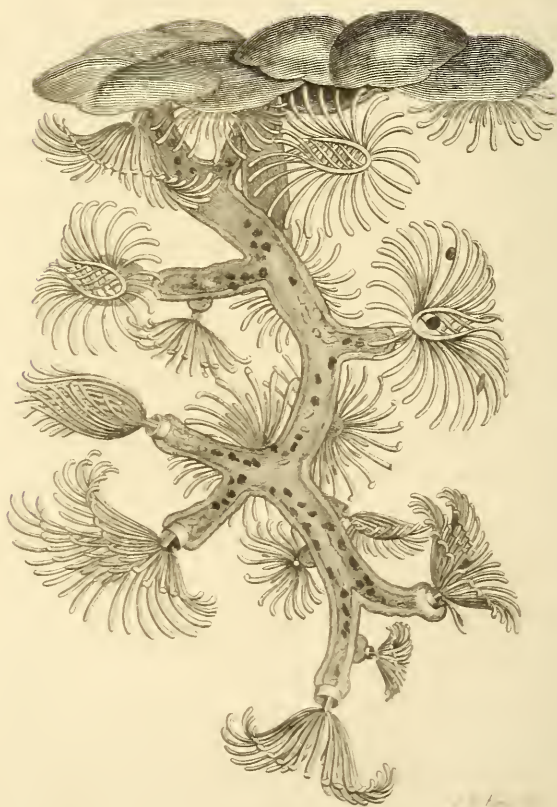
1813 & 1814 London Published by G. Hearsley Fleet Street

and shall begin with a genus of the smaller corals called *Sertularia*. The genus *Sertularia* is remarkable for its vegetable appearance, and is popularly considered as a kind of sea-moss. It is a genus which contains a vast number of species, some natives of our own coasts, and others exotic. Most of the species are, when dried, of a pale, semitransparent, yellowish-brown colour, and divided into very numerous ramifications. In the living or fresh state, the animal or Polype part may be observed to fill the whole, both of the stem and branches, and to send forth a head, with several arms, from every individual termination of the numerous branches. The whole therefore may be considered as a very compound or branched polype, defended by an elastic, horny covering. In the dried zoophyte the animal part shrinks up and becomes obliterated; the cortical part or case alone remaining. One of the most elegant species of *Sertularia*, and at the same time one of the most simple in its structure, is the *S. pinnata* or pinnated *Sertularia*, which is a native of our own coasts, and is found adhering to rocks, and often to oysters and other shell-fish: it seldom exceeds the height of about two inches; and its appear-

ance, when slightly magnified, is represented in the figures we are at present viewing, and in which the whole structure of the Zoophyte is clearly shown. Like others of its genus, it produces eggs, at particular periods, which are situated in the bottoms of the branches, and which produce young Zoophytes like the parent.

The Genus *Tubularia* is of uncommon elegance. It is of a softer nature than most other Zoophytes, except the Hydræ or proper Polypes; and some of the most beautiful species are natives of fresh waters, adhering to the stems of water-plants and other objects. The generic character of *Tubularia* is, a Zoophyte of a tubular structure, either simple or branched; fixed by its base; and protruding from the top of each tube a head, surrounded by numerous tentacula or arms, which are commonly placed in the form of a crescent or semicircle. It is hardly possible by any description to give an adequate idea of the beauty and elegance of some of the *Tubulariæ*. One of the largest species is a marine one, and is found on many of the European coasts, on rocks and shells, and consists of straitish or upright yellowish tubes, of the thickness of a small straw, and about three

TUBULARIA REPTANS

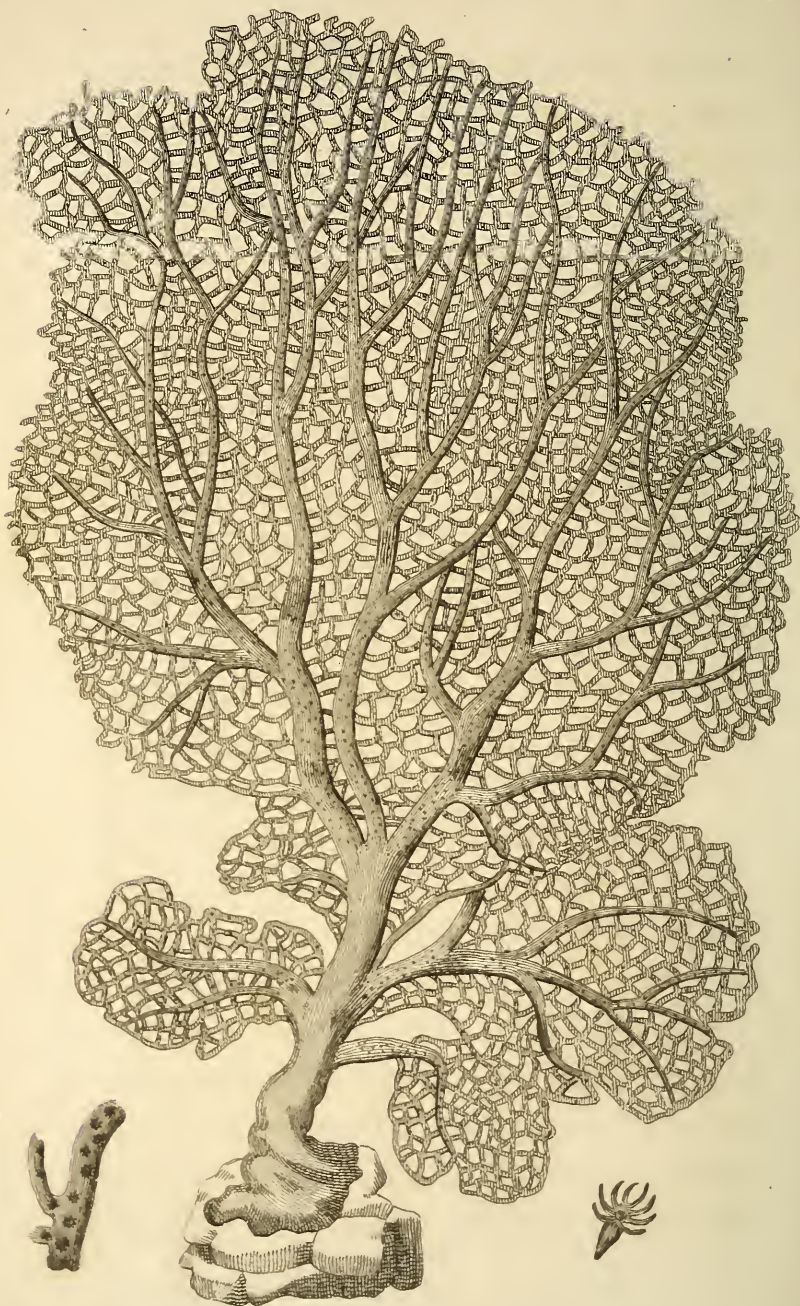
in its natural size*Magnified View of the*

TUBULARIA REPTANS

inches tall ; and from the top of each proceeds a crimson head, of the form before mentioned, and about three quarters of an inch in diameter. But the most beautiful are two species, by no means very uncommon in clear stagnant waters, where they adhere to various substances. The whole Zoophyte appears, at first view, like a small, transparent bladder, sometimes slightly, and sometimes very much branched, so as to extend to the distance of about two inches : and from the top of each of the divisions of the vesicular part proceed five or six, or sometimes ten heads, of the most beautiful transparent white, and of about the eighth of an inch or more in diameter ; each head being surrounded by sixty arms or tentacula, disposed in the form of a crescent, and generally in a state of rapid circular motion. These beautiful Zoophytes may be kept for many months in glasses of water, and exhibit a most elegant spectacle, especially when slightly magnified. These two fresh-water species vary a little in form, and are often confounded with each other. The one is the *Tubularia reptans*, and the other the *Tubularia campanulata* : In English they may be termed the Creeping or branching, and the Bell-shaped

Tubularia. The marine genus called *Flustra* at first view so much resembles a *fucus* or sea-weed, that it has been commonly described as such before the time of Mr. Ellis, who determined its real nature. It consists of flat, branched, leaf-like processes, each composed of very numerous cells, of a slightly horny or tough substance, open at the top, and affording a passage to the animal part or polype-head, which, in the recent zoophyte, protrudes through each cell; and the regular manner in which the cells are disposed, gives the leaf or plant-like appearance to the whole. The most common species is the *Fl. foliacea*, or broad-leaved *Flustra*, common on our own coasts.

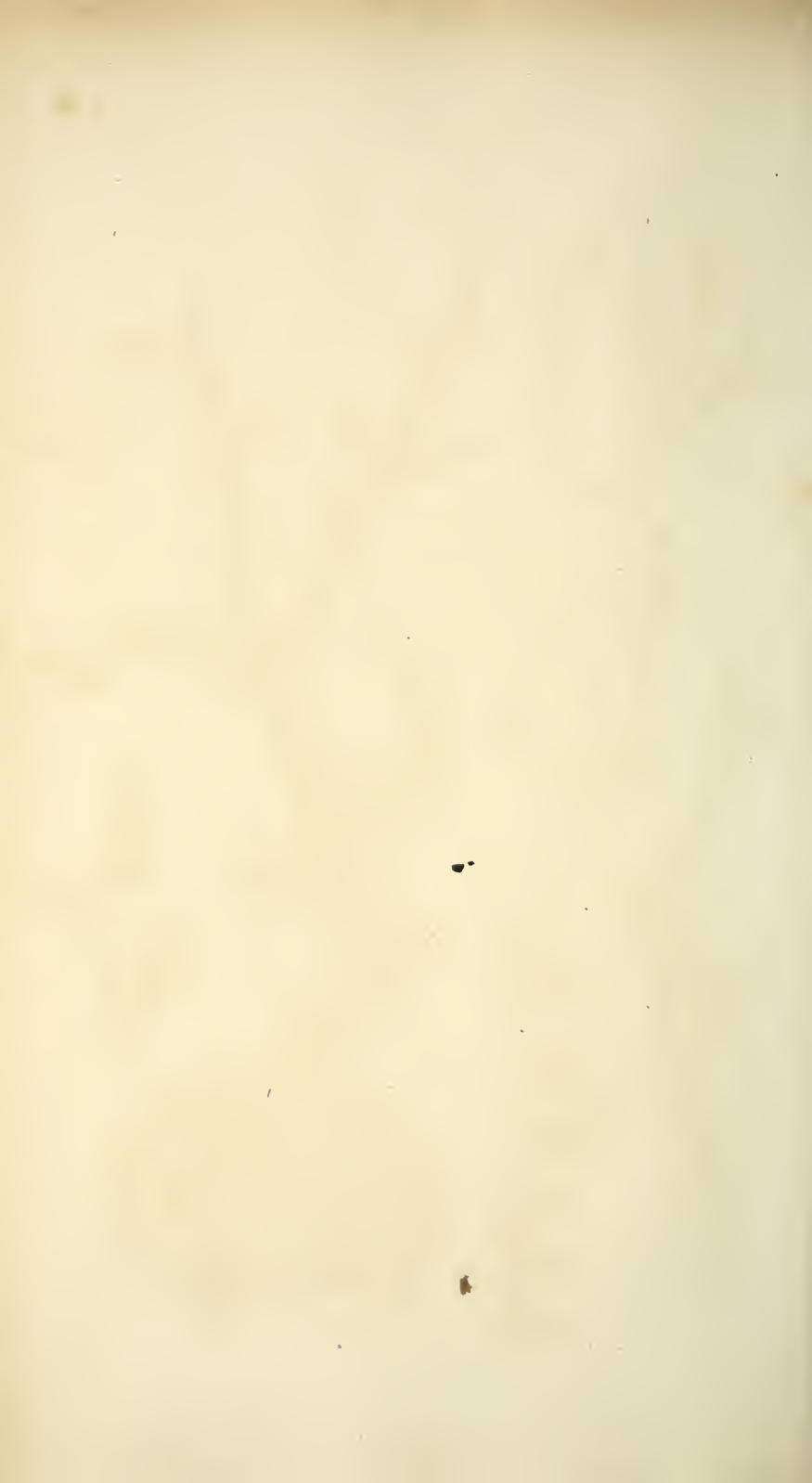
I shall now proceed to give an example or two of the principal genera of the hard or strong Zoophytes, more generally called Corals. Of these some are furnished with a kind of horny stem or central part, covered over throughout all the ramifications by a soft bark of a calcarious nature, and in which the animal or polype-like fabric is placed, while in other species the central part or stem is of a stony hardness, and is covered, in a similar manner, by a softer bark containing the animal part. The most remarkable genus of the hard

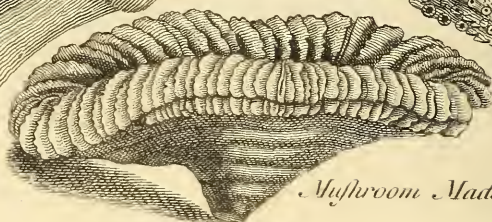
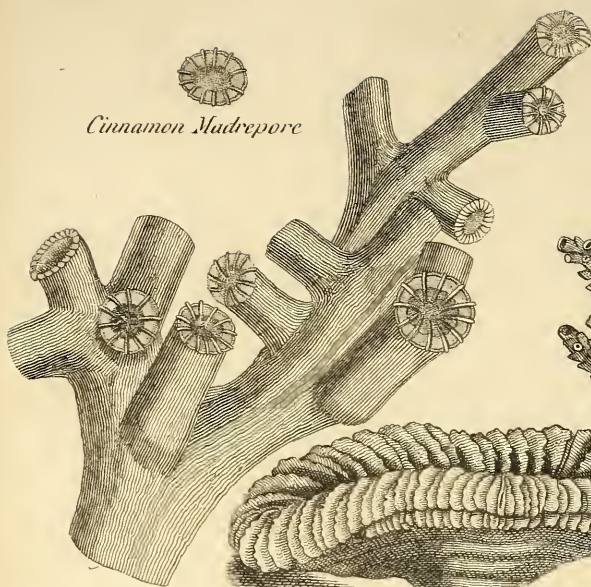
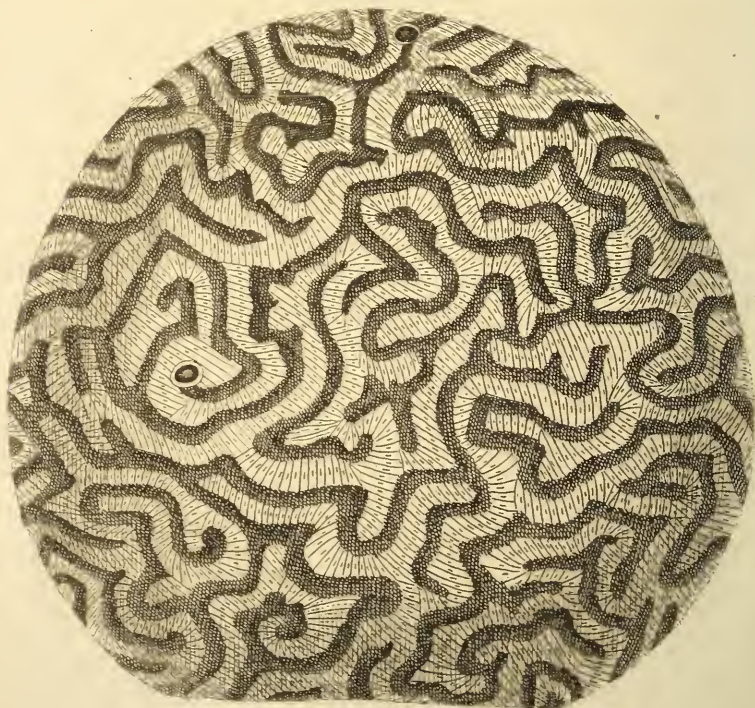


Corals is called *Gorgonia* or Gorgon. It contains a great many species, which differ greatly from each other in appearance, some being of a flattened and fan-shaped form; others rounded, and branched in the manner of trees. Of the fan-shaped gorgoniæ the species called the *G. Flabellum Veneris*, or Venus's Fan, is one of the most elegant. It is chiefly found on the rocks of the Indian and American seas, and grows to the height of two or three feet; its branches are so disposed as to resemble a kind of irregular network, and it is often seen in a proliferous state, many younger specimens branching out from the chief or principal one. Its colour is either purple or yellow, and sometimes intermixed. The stem or bone, when the soft part in which the polypes are placed is rubbed off, is of a horny substance, and of a blackish colour. But the species which of all others is most esteemed on account of the beauty of its colour, and the durability of its substance, is the common red Coral, which is the *Gorgoniapretiosa* of modern naturalists. Red Coral is a native both of the European and Indian seas; adhering to rocks, and growing in an inverted position. When recent, it is covered with a soft

fleshy coat or bark, of a red-lead colour, and beset with numerous small warts, from each of which proceeds a head of the general polype or animal part: those heads are divided into eight parts or arms, and, (as I had occasion before to observe), induced Count Marsigli to suppose that they were the flowers of the Coral. The red Coral, like most of the other Gorgoniæ, is first produced from a small egg. The eggs of this Zoophyte being discharged by the Polypes, fall on the rocks and attach themselves by their glutinous moisture, and when fixed begin to grow. Before the Coral is excluded from the egg it is quite soft, and has no appearance of the bony part; but when it has grown to the height of about the eighth of an inch, it assumes the hardness of bone, and begins to multiply its polype-heads, and to form new branches. I should here observe that Linnæus somewhat improperly placed the Red Coral in the genus *Isis*, under the name of *Isis nobilis*.

The genus *Isis* differs from that of *Gorgonia* in being of a jointed fabrick, instead of being composed of continued branchings. It is of a stony hardness, but the joints are of a horny nature, or much softer. The whole Coral is covered with a



*Cinnamon Madrepora**Mushroom Madrepora*

GORGONIA CEREBRUM
or *Brain Madrepora*

soft bark, in which, as in the rest of the tribe, are disposed the numerous branchings of the animal part. The most elegant species of Isis is an Indian Coral, growing to the height of about a foot, and of a white colour with the horny joints black. This, however, is the appearance of the Coral when dried, as it is usually seen in cabinets; but when recent, it is entirely covered with a soft whitish bark with numerous pores, from each of which protrudes a polype-head with eight arms.

Some of the Coral tribe have their animal part more nearly approaching (so far as we can trust to the observations hitherto made) to that of a Medusa than to that of a Polype. Of this kind are those very numerous Corals known by the title of Madrepores, and which constitute the Linnaean genus *Madrepora*. Their forms are very various, some being of a globular shape, others flattened, and others branched in various directions. They are generally marked with numerous star-shaped cavities, divided into several rays, but many are rather marked into various winding stripes composed of separate plates or laminæ; and all, when recent, exhibit a gelatinous animal substance situated either on the star-shaped cavities

or on the winding laminated part of the surface, according to the different species. The Madre-pores are of a stony hardness, and this stony or calcarious substance is perpetually secreted or deposited from the gelatinous animal part. The genus *Madrepora* is not only very numerous but very intricate; many of the species being difficult to describe, and their synonyms being often confounded by different authors. The very large globular Madrepores, covered with a winding or running pattern in the manner of a labyrinth, are commonly called Brainstones, and are often seen of such a size as to measure nearly two feet in diameter: others of similar shape are covered over with numerous star-shaped spots or impressions. Of the branched Madrepores one of the most remarkable is that called the Cinnamon Coral or Cinnamon Madrepore: it is often about a foot in height, and of a pale brown colour, and when recent, is said to diffuse a fragrant smell. The muricated Madrepore is distinguished by its remarkably roughened surface, rising into innumerable prominences, each perforated at the tip. This species varies, perhaps more than any other of the Coral tribe, exhibiting all the diversities

that can be imagined as to shape, but still preserving its particularity of surface.

Some of the Madrepores bear an appearance so perfectly similar to that of some kind of Mushroom, that they have often been considered as petrified Mushrooms. The Madrepores in general as well as the other larger Corals, are chiefly found about the coasts of the Indian islands, where they are so numerous as to form vast rocks, their animals seeming to carry on their work by a kind of instinct, continuing to grow in such a manner as to encircle a vast body of water, so as to form a calm or smooth bay. Within the tropical seas, according to the learned Dr. Reinhold Forster, in his ingenious dissertation on India, there are numerous small islands, but little elevated above the surface of the sea. All these are the work of marine Zoophyte Vermes, which raise on all sides their calcarious matter, from which at length are formed rocks and stony shallows, very dangerous to navigators. Easterly winds being most prevalent in these seas, the animals, as if actuated by instinct, endeavour to exclude the waves driven by the winds, by means of their stupendous works; and therefore, carrying on their habitations, they extend them

in long arms, which at last unite in a circle, within which they include a portion of calm, untroubled sea. On the opposite or windward side, the waves continually throw up fragments of corals, which, accumulating by degrees, form a mound against the billows; and on that part the sea is rendered gradually shallower; while, on the other side, immediately under the arms raised by the Zoophytes, the sea is of an astonishing depth; and not unfrequently, a part of the work remains open for the ingress and egress of the tide. In the coral banks themselves, sand is collected by the waves, affording soil and aliment for the seeds of shore plants brought thither by the sea; and these plants at length perishing, gradually create and accumulate a vegetable mould. If by chance a Cocoa-Nut be carried by the sea to these spots, it germinates, and grows into a tall tree, bearing, and disseminating many nuts, some of which again germinating, soon form a palm-grove, affording shade to birds and other animals, and supplying navigators, driven to the place by stress of weather, with a grateful food and liquor. The bay included within the arms of the Zoophytes is a receptacle for those fishes

which require a calm sea, and thus another food from the animal kingdom is presented to strangers. The shallows also afford a quiet and desirable situation to Mollusca, and shell-fish of all kinds, and contribute greatly towards supplying the inhabitants of the islands with a variety of food. Thus we perceive that the Coral tribe, however insignificant it may at first appear, is one of those powerful engines in the hand of the Author of nature which can produce the most stupendous effects from the most seemingly weak and unpromising agents.

After this general survey of the Zoophyte tribe, I shall beg leave to direct your attention to a Class of Animals which, till the latter part of the seventeenth century, had escaped all human attention and investigation, and constituted a kind of invisible world: a series of beings, the structure, powers, and properties of which, are perhaps more astonishing than those of most other animals: yet of such minuteness as, in general, to elude the sharpest sight, unless assisted by glasses. The ancients therefore were totally unacquainted with this class of beings. To them the Mite was made the *ne plus ultra*, or utmost bound of animal minuteness; but the moderns, assisted by the invention of the

Microscope, have discovered whole tribes of animals, compared to which even Mites may be considered as a kind of Elephants. These minute beings are chiefly to be observed in fluids of various kinds; and principally in such as have had any animal or vegetable substances infused in them; and for this reason they are often called in modern Zoology by the title of *Animalcula Infusoria* or Infusorial Animalcules. A most extraordinary idea was entertained by the celebrated Count de Buffon, relative to these Animalcules; viz. that they were not real animals, but a kind of organic particles or *Moleculæ*, which were capable, under certain circumstances, of being formed into animated beings. The experiments of Spallanzani and others have however completely overthrown this chimerical and absurd theory of the Count de Buffon; and indeed one would hardly think it possible for any person of unprejudiced mind, nay one may even add, of common sense, to view the several animalcules in fluids, and at the same time to doubt of their being real animals. Their rapid and various motions; their pursuit of the smaller kinds on which many of the larger prey; their avoiding each other as they swim; the curious

and regular structure of their bodies; and their whole appearance, form the most convincing proofs of their real animal nature and life.

Animalcules, as I before observed, are most frequently found in fluids; but this is a doctrine that has not always been clearly understood, and has been productive of some erroneous ideas in natural history. Some writers, for instance, have asserted that almost every kind of fluid abounded with animalcules; and that wines, and spirits, exhibited legions of them. This, however, is so very far from the truth, that none are ever to be discovered in inflammable spirits, or in any fermented liquor that has not passed either into the state of vinegar, or that is not grown completely vapid. As almost all extraordinary discoveries are liable, when related by unskilful persons, to have their circumstances exaggerated by additional ornaments, we need not be surprized that this has been the case relative to the History of Microscopic Animalcules. No sooner did the microscopical observations of Leewenhoeck and a few others become pretty generally known, than immediately, as if by a kind of fatality, the animalcular doctrine was carried a great deal too far;

and innumerable substances were supposed to swarm with these minute beings, which later and more accurate observations have proved to be totally free from them. Thus, the blueish or bloomy appearance on the surface of several sorts of plums, grapes, and many other fruits, has been supposed owing to innumerable legions of animalcules on the surface of the fruit: but this idea is entirely erroneous. It happens, a little unfortunately, that Mr. Pope has introduced it into his celebrated poem the *Essay on Man*, which still continues to propagate the mistake amongst those who are not scientifically conversant in such subjects.

“ Ev’n the blue down the purple Plum surrounds,
A living World, thy failing sight confounds.”

The blueish appearance above-mentioned is a mere vegetable efflorescence, which regularly takes place on such kind of fruit, and consists of particles of no determinate shape, and has not the least appearance that could lead to a supposition of its being of an animal nature.

To attempt a methodical enumeration of Ani-

malcules appears, at first view, almost a hopeless labour; since exclusive of the vast variety of species, (of which, in all probability, only a small part has yet been observed,) many of them have a power of changing their shape at pleasure; so as to appear widely different at particular times from what they did the moment before; and others, though their form is constant, are apt to vary in colour; by which means some deception or obscurity may arise, and an uncertainty in determining the species. Much, however, has been done: a great many species of Animalcules have been perfectly well described, and are perfectly well known to microscopical observers, since they possess characters too clear and plain to admit of any doubt of their species, whenever they happen to appear.

As examples of this curious and interesting race of animals I shall particularize a few of the most remarkable kinds, and such as are well figured in the works of Naturalists.

Among these the genus called *Vorticella* is one of the principal. Its character is, that the mouth or opening is surrounded by numerous short feelers, forming a kind of fringe round the head.

One of the most elegant species of *Vorticella* is the *Vorticella Convallaria*, a beautiful transparent animalcule, the body of which is formed like a bell-shaped flower, and is furnished with a very long tail or stem, by which it affixes itself to whatever substance it pleases. When a groupe of these animalcules is viewed by the Microscope, it exhibits the appearance of a set of animated flowers, alternately stretching out their stems at full length, and again suddenly contracting them in a spiral twist as represented in the figures we are now viewing. This species is very common, and is generally found attached to the stems and under surface of the leaves of the Common *Lemna minor* or Duckweed.

But a still more elegant species is the *Vorticella racemosa*. It is found during the summer months in clear stagnant waters, attached to the stalks of the smaller water plants and other objects; to the naked eye the whole groupe, on account of the great number of individuals composing it, is distinctly visible, in the form of a small whitish spot, resembling a kind of slime or mouldiness, but when placed under the microscope in a drop of water on a glass, its extraordinary structure is

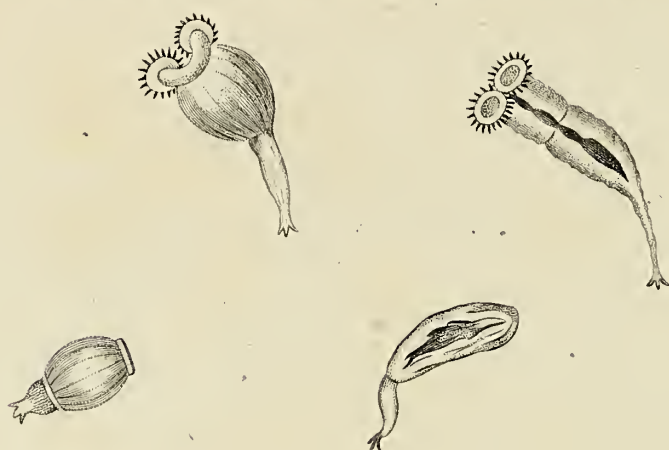


VORTICELLA RACEMOSA
*in its natural size, magnified
 & very highly magnified*

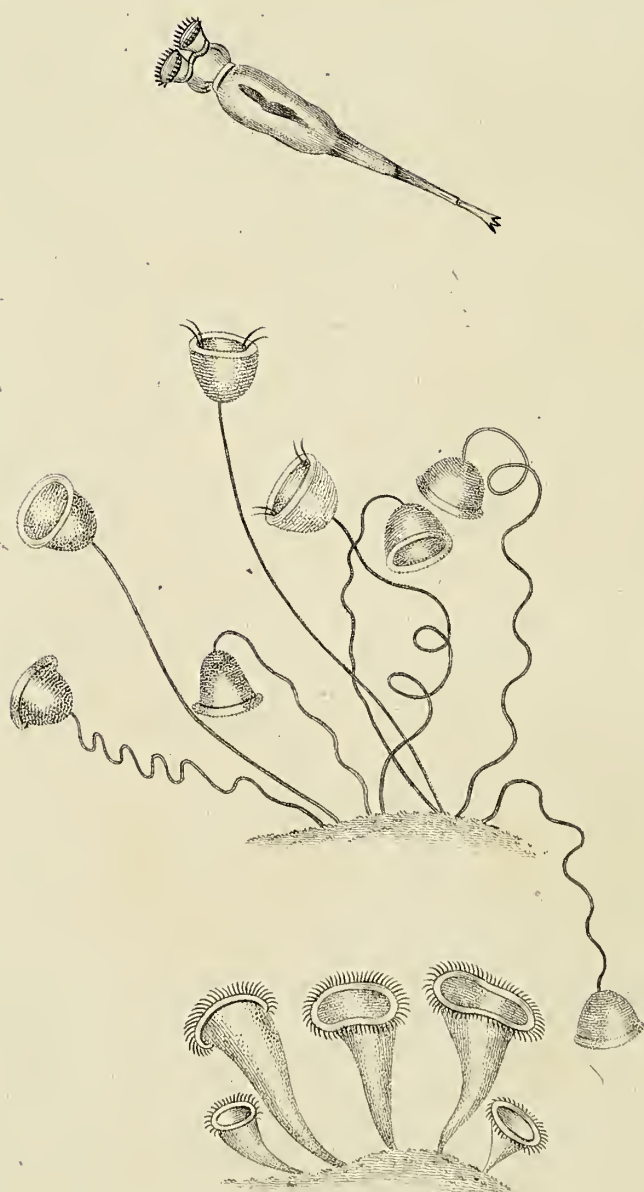




VORTICELLA ROTATORIA



VORTICELLA CAMPANULATA



Griffith sculp.

VORTICELLA STENTOREA

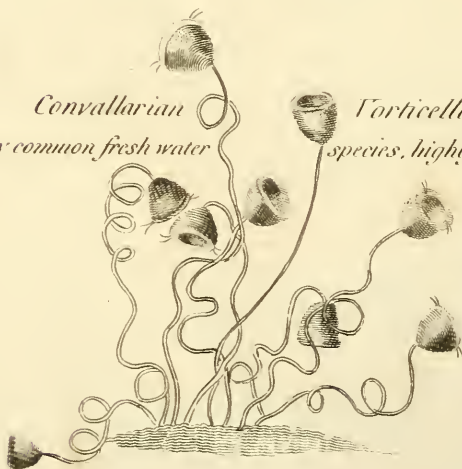


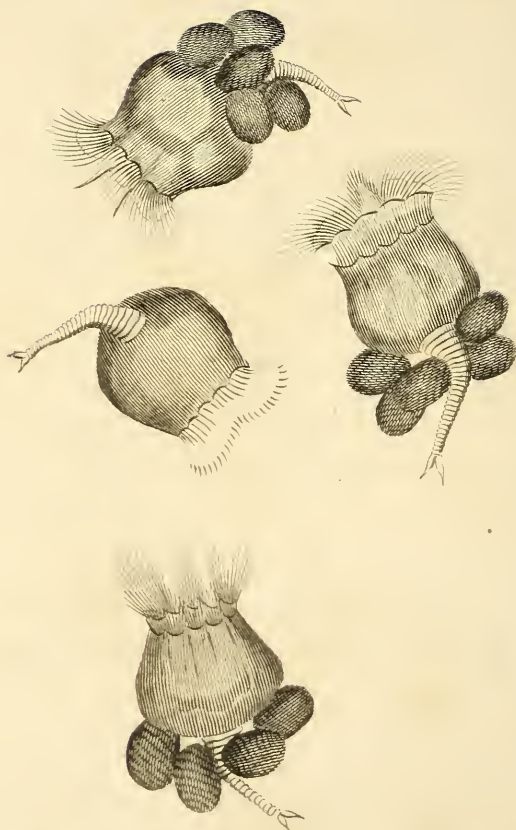
Vorticella
magnified & also in its
marine species & allied to

polypina
natural size. It is a
Vorticella racemosa

Convallarian
a very common fresh water

Vorticella
species, highly magnified





Vorticella urceolaris Lx. (*Brachionus capsuliflorus* Pall.)
 very common during the summer months in stagnant water.
 It is represented as very highly magnified.

immediately perceived. From a single stem proceed, at various distances, several smaller ramifications, each terminated by an apparent flower, like that of a *Convolvulus*, and furnished on the opposite edges, with a pair of filaments resembling stamina. The whole is in the highest degree transparent, and perfectly resembles the finest glass; while the varying motions of the seeming flowers, expanding and contracting occasionally, and turning themselves in different directions, afford a scene so singularly curious as to be numbered among the finest spectacles which the Microscope is capable of exhibiting. Each animal, though seated on the common stem, is complete in itself, and possesses the power of detaching itself from the stem, and forming a fresh colony from itself.

To the genus *Vorticella* also belongs the celebrated Animalcule called the Wheel-Animal, from the appearance which the head in some particular positions exhibits; as if furnished with a pair of toothed wheels, in rapid motion: this animalcule, which is called *Vorticella rotatoria*, has long ago been pretty well described and figured by Baker in his work on the Microscope: it is of a lengthened shape, and of a pale brown colour, and is of such a size

as to be sometimes perceptible by a sharp eye, even without a glass. It is remarkable for its strange power of reviviscence, or restoration to life and motion after being dried many months on a glass. The Wheel-Animal is often found on the scum covering the surface of stagnant waters, but more frequently in the water found in the hollows of decayed trees after rain.

In spring and summer nothing is more common than to see the surface of the smaller kind of stagnant waters covered with a fine deep-green scum; and frequently the same kind of greenness is diffused throughout the whole body of the water: this green colour is entirely owing to an Animalcule of a genus called *Cercaria* *. I have myself described it under the name of *Cercaria mutabilis* or Changeable *Cercaria*, because a variety sometimes occurs of a red colour. The animal is of a lengthened oval shape, with a slightly lengthened tail, the body or middle part appearing as if filled with very numerous green spawn or ova, while the extremities are transparent. It occurs at this season of the year in almost every puddle. The red variety is far less common, and the ap-

* Naturalist's Miscellany, vol. iii. pl. 107.



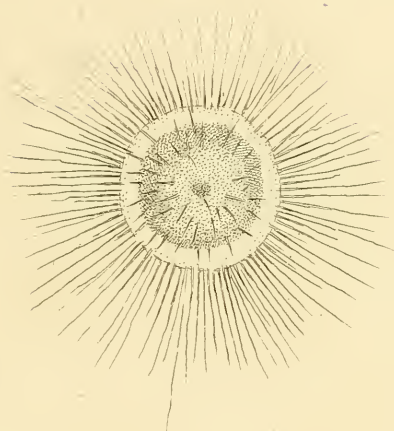
5 to 6 hours.

CERCARIA MUTABILIS
in various views

pearance which it exhibits is such as to alarm the superstitious with the idea of the water being changed into blood; a panic of which numerous instances have been adduced by authors, and which is the more excuseable in those who are ignorant of the cause, as the animalcules are so very small as to be utterly imperceptible, except to an uncommonly acute eye, without the assistance of the Microscope; so that even taking up and examining it affords no satisfactory elucidation to the vulgar. I remember to have more than once seen the whole surface of a large pond thus covered with this animalcule, of which there was not the least appearance the preceding day. It should be observed that some other animals, and particularly some small insects of the genus *Monoculus*, have occasionally produced a similar appearance: but in that case the demonstration becomes easy; since every one, on taking up the water, perceives the red insects. We are assured by Swammerdam that the whole city of Leyden was one morning in a state of consternation on discovering that the waters of that place were apparently changed into blood; but the philosopher soon had the satisfaction of undeceiving

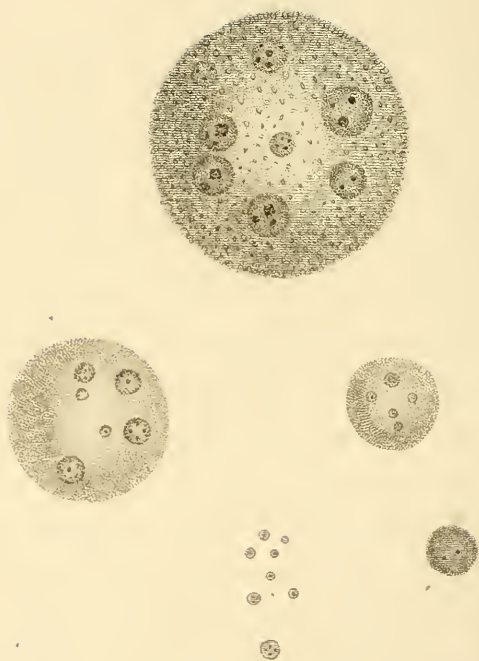
the people by demonstrating to them the real cause.

Among the most remarkable of the Animalcular tribe may be numbered a species of the genus called *Trichoda*, chiefly characterized by being beset with hairs or filaments. The species I have just mentioned is the *Trichoda Sol*; so named from its presenting the appearance of a sun, as generally expressed in engraving; viz. a globe or ball, beset on all sides with very long diverging rays, or spines. This animalcule is of a remarkably inactive nature, affixing itself to the stem of some small water plant, and occasionally moving at the rate of about a quarter of an inch in an hour. Its size may be considered as gigantic, for one of the animalcular tribe, being equal to that of a small pin's head. This animalcule may be pulled or torn in pieces, by means of a pair of needles or other convenient instruments, and in the space of a single hour each piece will be apparently complete, and perfectly globular like the original. It preys on small *Monoculi*, particularly on a very small species called by Linnæus *Monoculus Pediculus*, hardly larger than a grain of sand. The *Trichoda Sol* appears to have been first de-



TRICHODA SOL or SUN TRICHODA

*slightly magnified, with a view of the mouth
& one of the spines more highly magnified*



VOLVOX GLOBATOR
in its natural size & magnified

scribed by a German author of the name of Eichorn, and afterwards more fully by Müller.

The genus called *Volvox* also presents one of the largest and most curious of *Animalcules*, as well as one of the most beautiful, the chief species, or *Volvox Globator*, often equalling the size of a pin's head. In the advanced state of spring, and again in autumn, it appears in immense numbers in the clearer kind of stagnant waters. Its general colour is green; but it sometimes is of a pale orange-colour. Its motions are irregular, in all directions, and at the same time rolling or spinning as if on an axis. When microscopically examined it presents one of the most curious phenomena in natural history, being always pregnant with several smaller animals of its own kind, and these with others still smaller: the whole external surface is covered with very numerous small tubercles; which some have supposed to act as a kind of fins, while others have supposed them to be the valves of so many orifices which the creature can either open or close at pleasure, in order to manage its various motions. When groupes of these beautiful animalcules are viewed by the solar Microscope, they strongly recal to the recollection of the spec-

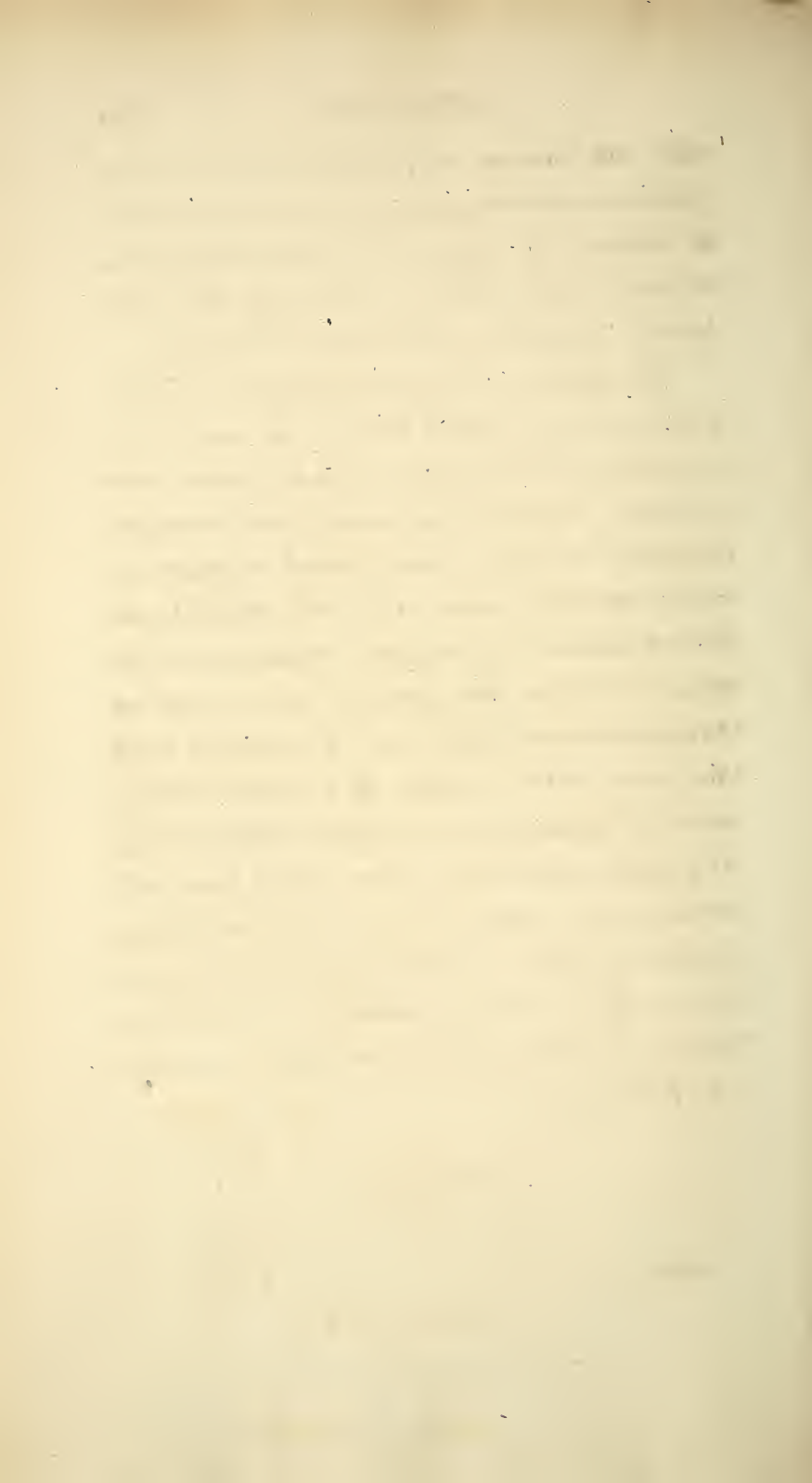
tator the magnificent scene in Mr. Walker's Eidouranion, representing numerous worlds revolving in various directions.

In a genus called *Vibrio*, from its vibrating or serpentine form and motion, we meet with the largest of all the Animalcular tribe; viz. the *Vibrio Anguillula* or *Eel-Vibrio*, of which one variety inhabits acid paste made of flower and water, or such as is used for the common purposes of bookbinding, and the other variety is often found in common vinegar. The paste *Vibrio* is distinctly visible to a good eye without a glass, and when full grown measures the tenth of an inch in length: it is viviparous, and frequently produces a tribe of young. Its general appearance when magnified is that of an Eel. This animalcule, from its size, and the ease with which it may at all times be kept and observed, is peculiarly interesting. It generally swarms on the surface of the paste, and often coats the sides of the vessel in which it is kept, often forming a kind of ramifications, resembling the branched appearance of frost on a window: this is particularly observable in rainy weather.

The genus *Cyclidium* is distinguished by its oval shape, and is among the smallest of Animal-



Magnified Views of
VIBRIO ANGUILLULA or EEL VIBRIO



cules: the common oval *Cyclidium* never fails to appear in countless swarms in any kind of vegetable infusion after the space of a few days; as in infusions of hay, beans, wheat, and other substances. Its motions are generally very rapid.

The smallest of all the Animalcular tribe belong to a genus called *Monas*: its character is an oval or roundish body, with a central point or speck. Whenever any kind of soft vegetable substance has been either infused or boiled in water, the water, when set by, will not fail to exhibit animalcules of this genus, sometimes in the space of twelve, but assuredly in the space of twenty-four hours afterwards. The smallest of all the genus, and the smallest of all animal beings, so far as human research is capable of discovering, is a species called *Monas Termo*, which when surveyed by the utmost powers of the microscope, still appears but as a kind of moving point, having merely a sensible diameter. It is found in various vegetable infusions, appearing in the space of a few hours.

THE END

NOTES CORRECTIONS AND

[illegible]

Vol. I. P. 110. The T. 110. and on this page of the American
Mammologist it may be added that Mamm. Ovaris is decid-
edly of opinion that it is not to be considered as an ex-
tinct animal greatly added to the T. 110. and which he
calls *Le G. 110. 110. 110.* The work he thinks were
situated in a small house with those of the T. 110.
and it appears to have been provided with a small room
or porch. See the work entitled *Journal de la Société*
of History. New York. See also

NOTES, CORRECTIONS, AND ELUCIDATIONS.

LECTURE IV.

Vol. I. P. 112. To what is said in this page of the American Mammoth it may be added, that Monsr. Cuvier is decidedly of opinion that it ought to be considered as an extinct animal greatly allied to the Elephant, and which he calls *Le Grande Mastodonte*. The tusks he thinks were situated in a similar manner with those of the Elephant, and it appears to have been provided with a similar trunk or proboscis. See the work entitled *Annales du Museum d'Histoire Naturelle*. No. 46.

LECTURE VI.

P. 215.—To what is here said of the Dodo add, that in some modern publications this bird is, by an enormous error, said to have no claws. This I suppose must have arisen from a typographical error in Gmelin's edition of the *Systema Naturæ*, where the description added to the specific character of the Dodo, concludes with the words *unguibus nullis* instead of *unguibus pullis*, dusky or black claws.

NOTES, CORRECTIONS,

LECTURE VII.

Vol. II. P. 5. l. 16.—The Amphibia whose eggs hatch internally, as Vipers, &c. should be termed ovi-viviparous.

LECTURE XI.

P. 168.—The genus *Teredo*, though differing widely in habit from most of the testaceous animals, will be found, if accurately considered, to approach in point of fabric to the inhabitants of the bivalves; and the jaws, as they are commonly termed, are in reality a pair of valves, and somewhat resemble those of the genus *Pholas*.

P. 181.—The inhabiting animal of the genus *Pinna* is in reality allied to that of *Mytilus* or *Muscle*. Its anatomy is detailed in the work of Poli.

P. 189. l. 13.—The Bivalve Shells are increased by a constant succession of new laminae, as well as by the enlargement of the outline or circumference of the valves.

LECTURE XII.

P. 218.—The figure accompanying the short description here given of the *Vorticella racemosa* is taken from a small specimen, and though executed with sufficient fidelity as to its general appearance, fails in expressing the incomparable elegance of the animal itself. Indeed

it is scarcely possible by any figure to express the genuine habit of the animal, especially when arrived at its full growth, when the branchings are extremely numerous. It may be added that two or three distinct species of this kind of compound Vorticellæ exist, which are all evidently confounded by Linnæus and some others under the name of *Vorticella anastatica*. Their general mode of growth or increase is as follows: viz. the first or parent animal swims single, and is furnished with an extremely short stem, hardly equalling the length of the body; but which, in a few hours, extends to a surprising degree, and becomes the chief or general stem: after this the body divides longitudinally, forming two distinct and similar bodies, whose respective stems very soon begin to lengthen, and, after some hours, each of these two bodies again divides, forming double the former number. This method of increase is continued till all the numerous branches of the animal tree are formed; and when it has thus remained for the space of eight, ten, or even many more days, the several animals separate, in succession, from their respective branches or stems, and swim about in order to form new colonies; so that in the space of some days the tree is left perfectly bare. To this, which is the general mode of increase, the accurate Muller has added a still more surprising one, viz. that the naked stems again repullulate, producing new heads or bodies in place of those which have departed. This latter mode of increase, I must confess, has never yet fallen under my own ob-

NOTES, &c.

servation, and is allowed to be somewhat doubtful even by Muller himself.

P. 216.—The distich quoted in this page is not from Pope's Essay on Man, but from a poem by Boyse.

NOTES

and is allowed to be somewhat doubtful even
of what is possible.

P. 246 - The statement of the fact is not true
I have found it true in some of the cases.

ERRATA.

VOL. I.

- LECT. I. p. 22. l. 11. For *say she* read *says he*.
II. p. 40. l. 1. For *manner* read *manners*.
II. p. 59. in the note. For *preferred* read *referred*.
III. p. 81. l. 2. For *oviparous* read *ovi-viviparous*.
III. p. 85. l. 18. For *Ichnuemon* read *Ichneumon*.
III. p. 88. l. 6. For *ten in the upper* read *ten in the upper jaw*.
IV. p. 120. l. 18. For *in the mouth* read *by the mouth*.
IV. p. 124. l. ult. For *descendents* read *descendants*.
IV. p. 139. l. 9. For *longer* read *larger*.
V. p. 158. l. 10. For *hypochondriac and unpygial feathers*
read *hypochondrial and uropygial feathers*.
V. p. 176. l. 2. For *Tinian* read *Quibo*.
V. p. 182. l. 12. For *seem to have been copied*, read *seem to*
have been all copied.
VI. p. 209. l. 22. For *Carthage* read *Cathaye*.
VI. p. 241. l. 19. For *o* read *of*.

VOL. II.

- VIII. p. 65. l. 5. For *it will* read *he will*.
VIII. p. 65. l. 21. For *one intermixed* read *once intermixed*.
IX. p. 110. l. 17. For *Class* read *Order*.
IX. p. 112. l. 14. For *one* read *once*.
X. p. 145. l. 20. For *S. S.* read *G. S.*
XII. p. 207. l. 21. For *Gorgoniap retiosa* read *Gorgonia pre-*
tiosa.



